

DEP SPECIFICATION

QUALIFICATION OF INSULATION FOR DEEPWATER APPLICATIONS

DEP 37.81.41.37-Gen.

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DESIGN AND ENGINEERING PRACTICE



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TABLE OF CONTENTS

1.	INTRODUCTION	4
1.1	SCOPE	4
1.2	DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS	4
1.3	DEFINITIONS	4
1.4	CROSS-REFERENCES	5
1.5	COMMENTS ON THIS DEP	5
1.6	DUAL UNITS	5
2.	INSULATION MATERIALS	6
2.1	GENERAL	6
2.2	MATERIAL TYPES	6
2.3	FUNCTIONAL REQUIREMENTS	6
3	GENERAL REQUIREMENTS	7
3.1	GENERAL	7
3.2	DESIGN PROPERTIES	7
3.3	MATERIAL CHARACTERISTICS	7
3.4	SYSTEMS TESTS	7
4	PROPERTIES AND TEST METHODS	8
5	MATERIAL QUALIFICATION	11
6	APPLICATION QUALIFICATION	13
7	QUALITY CONTROL (RAW MATERIALS AND FINAL PRODUCT)	15
8	REFERENCES	17

APPENDICES

APPENDIX A	SYSTEMS TESTS	19
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1. INTRODUCTION

1.1 SCOPE

This new DEP specifies requirements and gives recommendations for qualifying insulation materials for subsea applications. The purpose of qualification is to ensure that the product as manufactured can meet the system performance requirements.

Insulation systems for deepwater applications are specified in the following standards:

- DEP 37.81.41.36-Gen.
- DEP 37.81.40.30-Gen.

Key properties of insulation materials and criticalities of these key properties are given as background in the companion Informative.

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 on deepwater projects involving subsea:

- Flowlines
- Trees
- Jumpers
- Manifolds/sleds

Application in other facilities may also apply.

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 **should** indicates a recommendation.

1.3.2 Abbreviations

Term	Definition
OHTC	Overall Heat Transfer Coefficient
PVC	Polyvinyl Chloride

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 (8).

1.5 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://www.shell.com/standards> and on the main page of the DEPs DVD-ROM.

1.6 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. INSULATION MATERIALS

2.1 GENERAL

Insulation materials to be applied in wet insulation applications shall be qualified in accordance with this DEP.

The acceptance criteria and selection of approved insulation systems will be determined by the Principal and will vary for each project depending on the service and installation conditions.

2.2 MATERIAL TYPES

The four most common used polymers for insulation purposes are:

- Polyurethanes
- Epoxies (amine cured or anhydride cured)
- Polypropylene
- Silicones

Other polymers used include polyvinyl chloride (PVC), polyester, vinyl ester, neoprene and EPDM rubber, polyethylene and polystyrene.

These materials may be used in various physical forms: solid, foam, pure syntactic (glass microspheres only), and composite syntactic (micro and macro spheres).

2.3 FUNCTIONAL REQUIREMENTS

In general, the insulation systems shall be designed to achieve one or both of the following:

- Provide the required insulation capacity for the system (U-value) under service conditions
- Provide a specified cool-down time

3 GENERAL REQUIREMENTS

3.1 GENERAL

In selecting insulation systems, there are many potentially important design properties, which are affected by the material characteristics. The standard tests defined in (4) shall be applied to the determine bulk material properties listed in (3.2) through (3.3).

In addition, the system tests listed in (3.4) shall be performed to evaluate the applied material for installation and operation requirements.

3.2 DESIGN PROPERTIES

- a) Thermal Conductivity (dry and wet)
- b) Heat Capacity
- c) Density
- d) Glass Transition Temperature
- e) Continuous Use Temperature
- f) Coefficient of Thermal Expansion

3.3 MATERIAL CHARACTERISTICS

- a) Water Absorption
- b) Hydrostatic Strength
- c) Hardness
- d) Abrasion Resistance
- e) Impact Strength
- f) Tensile Modulus
- g) Tensile Strength
- h) Tensile Elongation
- i) Uniaxial Compressive Strength
- j) Hydrostatic Creep
- k) Flammability
- l) UV Resistance
- m) Heat of Cure
- n) Thermal Aging
- o) Porosity/Air Entrapment

3.4 SYSTEMS TESTS

- a) Simulated Service Test
- b) Thermal Shock Resistance Test
- c) Proof Testing (Shell prescribed)
- d) Bending Test
- e) Tensioner Test
- f) Flexural Fatigue Test
- g) Stinger Roller Test
- h) Shear Adhesion Test
- i) Cathodic Disbondment Test

4 PROPERTIES AND TEST METHODS

Table 1 gives a recommended list of the properties to be measured, test methods and typical values.

Table 1 List of Key Material Properties

Property	Acceptable Standards	Typical Values	Units	Comments
1. Thermal Conductivity (Dry and Wet)	ASTM C518 ASTM C177 ASTM F433	< 0.160 (0.092)	W/(m.K) (Btu/ft-hr-°F)	See Note 1
2. Water Ingress	ASTM D2842 ASTM D 570	< 5	%	Tests shall be conducted at (or above) the maximum flowline operating temperature <u>and</u> at 23°C (73°F) at the site water depth pressure. (example: 93°C/3000 psi and 23°C/3000 psi.) Results shall be reported in percent weight gain along with the surface area exposed. Use of. 75 mm x 13 mm x 3 mm (3 in x 0.5 in x 0.125 in) specimens with machined surfaces in ASTM sea water is recommended. Results shall be reported after 1, 3, 7, 28 and 56 days immersion.
3. Hydrostatic Strength		>1.5 x Water Depth	MPa (psi)	Tests shall be conducted at (or above) the maximum operating temperature and at 4°C (39°F).
4. Heat Capacity	ASTM E1269 ASTM D2766		kJ/(kg.K) (Btu/lb-°F)	See Note 1
5. Density	ASTM D 792 ASTM D1622		kg/ m ³ (lb/ft ³)	See Note 1