TECHNICAL SPECIFICATION

ELECTROLESS NICKEL PLATING
(AMENDMENTS/SUPPLEMENTS TO ASTM B 733)

DEP 30.48.41.31-Gen.

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DESIGN AND ENGINEERING PRACTICE

PREFACE

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Shell International Oil Products B.V. (SIOP)
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Shell International Exploration and Production B.V. (SIEP)
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Shell International Chemicals B.V. (SIC)

The Hague, The Netherlands,

and other 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 Group Operating companies. Where appropriate they are based on, or reference is made to, national and international standards and codes of practice.

The objective is to set the recommended standard for good design and engineering practice applied by Group 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 users 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 companies to adapt the information set forth in DEPs to their own environment and requirements.

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NOTE: In addition to DEP publications there are Standard Specifications and Draft DEPs for Development (DDDs). DDDs generally introduce new procedures or techniques that will probably need updating as further experience develops during their use. The above requirements for distribution and use of DEPs are also applicable to Standard Specifications and DDDs. Standard Specifications and DDDs will gradually be replaced by DEPs.

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PART I INTRODUCTION

1.1 SCOPE

This DEP specifies requirements for the application of electroless nickel plating (ENP) on metals for the purpose of improving the **wear resistance** of the base metal (carbon steels and stainless steels).

ENP shall not be applied for the purpose of **corrosion protection**.

ENP may be used for operating temperatures up to and including 200 °C, but in the presence of hydrogen sulphide or sulphur compounds the maximum operating temperature

shall be restricted to 80 °C.

Part II of this DEP is written in the form of amendments and supplements to ASTM B 733 (1990).

The process of ENP is described in ASTM B 656, and the guidance given therein shall be followed. However, in case of conflicting requirements the requirements of this DEP shall prevail.

This DEP is a revision of the previous publication of the same number dated January 1986.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by SIOP and SIEP, the distribution of this DEP is confined to companies forming part of the Royal Dutch/Shell Group or managed by a Group company, and to Contractors and Manufacturers/Suppliers nominated by them (i.e. the distribution code is "F", as described in DEP 00.00.05.05-Gen.).

This DEP is intended primarily for use in oil and gas production facilities.

If national and/or local regulations exist in which some of the requirements may 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 as regards 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 with the object of obtaining agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

The **Contractor** is the party which 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 which manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party which 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 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 (Part III).

PART II AMENDMENTS AND SUPPLEMENTS TO ASTM B 733

The amendments/supplements in this Part refer to the section numbers of ASTM B 733. Sections of ASTM B 733 that are not mentioned shall apply as written.

4.2.1 Add the following:

Service condition SC 4 (very severe service) shall apply and the coating thickness shall be 50-75 µm.

4.3 Add the following:

The coating shall be type II, with an additional test for chemical composition (7.1.1).

The internal stresses of the coating shall be compressive and shall be controlled in accordance with ASTM B 636 or an equivalent technique agreed by the Principal.

4.4 Add the following:

The heat treatment class shall be Class 2.

6.1 Add the following:

Generally, surface cleaning shall follow as a minimum the standard practice described in ASTM B 322. Final preparation of the base material prior to deposition of the coating shall be in accordance with ASTM B 183 for carbon and low-alloy steels or with ASTM B 254 for stainless steels, except that hydrochloric acid shall not be used for acid pickling.

On component parts which have to be hard-die stamped with an identification symbol and/or mark, the position of the marking (in a non-critical area) shall be agreed between the Principal and the Manufacturer. Stamping shall be done using low-stress stamps prior to the commencement of cleaning.

6.3.1 Replace with the following:

Parts with a tensile strength $\geq$ 1050 MPa shall be stress relieved before plating in accordance with the table in 6.4.

6.3.2 Delete this section.

6.4 Delete the first paragraph of this section (the table remains).

6.5 Replace this section by:

Peening shall not be applied.

6.7.1 Add the following:

Stabilizers used in the plating bath shall be basically organic stabilizers and shall be free of calcium, bismuth and sulphur. Lead may be present up to a maximum concentration of 2 mg/kg.

6.8 Delete this section (not applicable).

7.1.1 Replace this section by:

The chemical composition of the deposited coating, measured in accordance with 9.1.1, shall conform to the following:

CHEMICAL ELEMENT COMPOSITION LIMITS		
P	Other elements	Ni
7% - 13%	0.05% max.	Balance

7.3.1 Add the following:

The thickness shall be determined in accordance with 9.3.2 for ferritic substrates with coatings within the application range of 9.3.2, or in accordance with 9.3.1 for non-magnetic substrates and those ferritic substrates that fall outside 9.3.2.

7.4 Replace this section by the following:

To verify satisfactory adhesion of the coating to the base material, the plated article shall satisfy the burnishing test described below:

An area of approximately 500 mm^2 of the plated article shall be rubbed rapidly and firmly for 15 seconds with a smooth metal implement, such as a steel bar 6 mm in diameter with a smooth hemispherical end. The pressure applied shall be sufficient to burnish the plating at each stroke, but not so high as to cut it. Blisters, lifting or peeling of the plating are evidence of inadequate adhesion.

Additionally, the coupons (8.2) shall be tested in accordance with 9.4.1.

7.6.1 Replace with the following:

The coating shall be free of pores, cracks or other through-thickness imperfections, when tested according to 9.6.1 (ferroxyl test) for carbon steels and 9.6.2 (hot water test) for stainless steels.

7.7 Delete this section

8. Replace this section with the following:

8.1 Sampling

Sampling for non-destructive testing shall be carried out in accordance with ASTM B 602, Table 1, Level I.

Sampling for destructive testing shall be carried out in accordance with ASTM B 602, Table 4.

8.2 Test Coupons

Test coupons of the base material plated simultaneously in the same bath may be used as an alternative to comply with all the required tests, except that the burnishing test (7.4) shall always be done on the plated article.

PART III REFERENCES

In this DEP, reference is made to the following publications:

NOTE: Unless specifically designated by date, the latest edition of each publication shall be used, together with any amendments/supplements/revisions thereto.

SHELL STANDARDS

Index to DEP publications and standard specifications	DEP 00.00.05.05-Gen.

AMERICAN STANDARDS

Standard practice for preparation of low-carbon steel for electroplating.	ASTM B 183
Standard practice for preparation of and electroplating on stainless steel.	ASTM B 254
Standard practice for cleaning metals prior to electroplating.	ASTM B 322
Standard test method for attribute sampling of metallic and inorganic coatings.	ASTM B 602
Standard test method for measurement of internal stress of plated metallic coatings with the spiral contractometer.	ASTM B 636
Standard guide for autocatalytic (electroless) nickel-phosphorus deposition on metals for engineering use.	ASTM B 656
Standard specification for autocatalytic nickel-phosphorus coatings on metals.	ASTM B 733 - 90

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