

JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS H 8645 : 1999

Autocatalytic nickel-phosphorus coatings on metals

ICS 25.220.40; 77.220.40

Descriptors : nickel, phosphorus, metal coatings, wear resistance, corrosion protection,
metal plating

Reference number : JIS H 8645 : 1999 (E)

H 8645 : 1999

Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of International Trade and Industry through deliberations at the Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law. Consequently **JIS H 8645:1989** is replaced with **JIS H 8645:1999**.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

Date of Establishment: 1989-02-01

Date of Revision: 1999-08-20

Date of Public Notice in Official Gazette: 1999-08-20

Investigated by: Japanese Industrial Standards Committee
Divisional Council on Non-Ferrous Metals

JIS H 8645:1999, First English edition published in 2000-12

Translated and published by: Japanese Standards Association
4-1-24, Akasaka, Minato-ku, Tokyo, 107-8440 JAPAN

In the event of any doubts arising as to the contents,
the original JIS is to be the final authority.

© JSA 2000

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

Printed in Japan

Autocatalytic nickel-phosphorus coatings on metals

Introduction This Japanese Industrial Standard has been prepared based on the corresponding parts to International Standard shown in Remarks to clause 1 **Scope** without any modification in the technical contents, however, some specifications, which are not specified in the corresponding International Standards, have been supplemented in this Standard.

1 Scope This Japanese Industrial Standard specifies autocatalytic nickel-phosphorus coatings⁽¹⁾ (hereafter referred to as "coatings") applying on significant surface of such basis metal as iron, copper, aluminium, and their alloy to improve corrosion resistance, abrasion resistance, and others.

Note ⁽¹⁾ This is autocatalytic type nickel-phosphorus coating by the reduction using hypophosphorous acid, that produce a deposit mainly of nickel containing 2 % to 15 % of phosphorus.

Remarks: The International Standard corresponding to this Standard is as follows.

ISO 4527 : 1987 Autocatalytic nickel-phosphorus coating — Specification and test methods

2 Normative references The following standards contain provisions which, through reference in this Standard, constitute provisions of this Standard. The most recent editions of these standards indicated bellow shall be applied.

JIS B 0651 *Surface texture — Instruments for the assessment of surface texture — Profile method*

JIS C 0050 *Basic environmental testing procedures Part 2: Tests, Test T: Soldering*

JIS G 1204 *General rules for fluorescent X-ray analysis of iron and steel*

JIS H 0400 *Glossary of terms used in electroplating and related processes*

JIS H 0404 *Graphical symbol for electroplated coating*

JIS H 8501 *Methods of thickness test for metallic coatings*

JIS H 8502 *Methods of corrosion resistance test for metallic coatings*

JIS H 8503 *Methods of wear resistance test for metallic coatings*

JIS H 8504 *Methods of adhesion test for metallic coatings*

JIS K 0050 *General rules for chemical analysis*

JIS K 0115 *General rules for molecular absorptiometric analysis*

JIS K 0119 *General rules for X-ray fluorescence spectrometric analysis*

JIS K 8001 *General rule for test methods of reagents*

JIS Z 2251 *Knoop hardness test — Test method*

JIS Z 3282 *Soft solders — Chemical compositions and forms*

JIS Z 9031 *Random sampling methods*

3 Definition For the purposes of this Standard, the definitions in **JIS H 0400** apply, and that of other main terms are as follows.

- a) **significant surface** The part plated or to be plated and for which the coating is essential for main performance and/or appearance.
- b) **heat treatment** The treatment by applying heat used to modify the hardness of coatings, or improve its wear resistance and adhesion.

4 Grade and symbols

- a) **Grade** The grades of coatings are classified into 7 depending on the minimum thickness of coatings as shown in Table 1.
- b) **Symbols** The symbols for coatings shall follow **JIS H 0404**.

Table 1 Grade and the minimum thickness of coatings

Unit: μm

Grade	Basis metal	Minimum thickness of coatings	Informative reference Use
Grade 1	Iron and iron alloy Copper and copper alloy Aluminium and aluminium alloy	3	Soldering
Grade 2	Iron and iron alloy Copper and copper alloy Aluminium and aluminium alloy	5	Corrosion prevention, Soldering
Grade 3	Iron and iron alloy Copper and copper alloy Aluminium and aluminium alloy	10	Corrosion prevention, Abrasion resistance
Grade 4	Iron and iron alloy Copper and copper alloy Aluminium and aluminium alloy	15	Corrosion prevention, Abrasion resistance
Grade 5	Iron and iron alloy Copper and copper alloy Aluminium and aluminium alloy	20	Corrosion prevention, Abrasion resistance
Grade 6	Iron and iron alloy Copper and copper alloy Aluminium and aluminium alloy	30	Corrosion prevention, Abrasion resistance
Grade 7	Iron and iron alloy Copper and copper alloy Aluminium and aluminium alloy	50	Corrosion prevention, Abrasion resistance

5 Quality

5.1 Appearance of coatings When a coating is tested on the appearance according to 11.2 it shall be flat and smooth and free from pit, blister, peeling, crack, exposure of base metal or undercoat, and free from other defects detrimental to service.

5.2 Chemical composition of coating film The chemical composition of coating film, when tested according to 11.3, shall conform to the requirements specified in Table 2.

5.3 Surface roughness of coatings When the surface roughness of coatings is tested according to 11.4, the result value shall follow the agreement between the parties concerned with delivery.

5.4 The minimum thickness of coating The minimum thickness of coating, when tested according to 11.5, shall be conform to the requirements in Table 1.

5.5 Hardness of coatings When the hardness of coating is tested according to 11.6, the value shall be vickers hardness 500 or more and Knoop hardness 450 or more.

Annex 7 (informative) shows the conditions for heat treatment required to achieve Vickers hardness of 600 to 1 000.

Remarks: The coating thickness of sample shall be at least 50 μm .

5.6 Adhesion of coating When the adhesion of coating is tested according to 11.7, no peeling or blister of the coating shall occur.

5.7 Porosity of coating When the porosity of coating is tested according to 11.8, the quality shall follow the agreement between the parties concerned with delivery.

5.8 Corrosion prevention of basis metal When the corrosion prevention of basis metal is tested according to 11.9, the quality shall follow the agreement between the parties concerned with delivery.

5.9 Corrosion resistance of coating film When the corrosion resistance of coating film is tested according to 11.9 after post-treatment of coating, the result shall meet the rating number specified in JIS H 8502 of at least 9. The post-treatment, duration needed for test, and appearance change are specified by the agreement between the parties concerned with delivery.

Remarks: Depending on the necessity, it may be evaluated by the corrosion-loss test method specified in JIS H 8502.

5.10 Wear resistance of coating When the wear resistance of coating is tested according to 11.10, the evaluation shall follow the agreement between the parties concerned with delivery.

Remarks: The coating thickness of sample shall be at least 20 μm .

5.11 Solderability of coating When the solderability of coating is tested according to 11.11, the part immersed shall show uniform wet state, and the surface of soldered spot shall be flat and free from nodule.

Remarks: When, after solderability of coating was tested, the bending test listed in 11.7, adhesion test is carried out, no coming off of the solder like scale, or no its peeling off shall occur.

Table 2 Chemical composition of coating film

Unit: %

Chemical composition		
Ni	P	Other elements
83 to 98	2 to 15	0 to 2

6 Basis metal The condition of basis metal before plating gives serious influences on the quality of coating, therefore especially when the basis material is supplied by an orderer, the orderer shall supply the information on the basis material in the process specification or others.

Remarks: The plater inspects the defects on basis metal which may be detrimental to the final finish with naked eyes. Any defects shall be brought to the attention of the orderer before processing.

7 Shot peening treatment When shot peening treatment is specified in order to improve fatigue strength, the conditions for treatment shall follow the agreement between the parties concerned with delivery.

Where no particular specification on peening strength is given, establish the peening strength in accordance with the method specified in Annex 1.

8 Undercoat When undercoat is required for the purpose of improving the adhesion, preventing coating diffusion, preventing plating bath contamination, the type of coating and its thickness shall follow the agreement of between the parties concerned with delivery.

9 Stress relief before plating When the stress relief of the articles made of iron or steel or copper alloy is required before plating, the conditions shall follow the agreement between the parties concerned with delivery.

The conditions for heat treatment to relieve stress before plating specified in the corresponding International Standard as informative reference are described in Annex 8 (informative).

10 Hydrogen embrittlement relief after plating When hydrogen embrittlement relief of the iron or steel products or other products after plating is specified, the conditions shall follow the agreement between the parties concerned with delivery.

The conditions of heat treatment for hydrogen embrittlement relief after plating specified in the corresponding International Standard as informative reference are described in Annex 9 (informative). The method to measure the decrement of brittleness is described in Annex 2.

Remarks: The heat treatment shall be started within 4 hours from when plating was finished.

11 Test

11.1 Preparation of test piece Generally, a test piece is prepared from a product. When, however, the plated product itself cannot be used for test piece, a substitute test piece is used for test.

The substitute test piece shall be prepared using the same basis metal, under the same conditions as those employed when product is manufactured as far as possible.

11.2 Appearance test Appearance test shall be carried out with naked eyes to check the defects of coatings such as roughness, burnt deposit, crack, pit, exposure of basis metal, and sign of poor adhesion, presence of stain or frow.

11.3 Analysis test The analysis test of chemical component shall be carried out according to the method specified in Annex 3 to determine the content of nickel and phosphorus in the coating.

The analysis test of other elements shall follow the agreement between the parties concerned with delivery

11.4 Roughness test Roughness test shall be carried out using the implements specified in JIS B 0651.

11.5 Thickness test Thickness test shall be carried out by any one of the following. Microscopic cross-sectional method, coulometric method, fluorescent X-ray method, beta back scatter method, eddy current method, scanning electron microscope method, or mass weighing method, which are specified in JIS H 8501.

11.6 Hardness test Hardness test shall be carried out according to the test method specified in JIS Z 2251.

11.7 Adhesion test Adhesion test shall be carried out by any one of the following. Bending test method, thermal-shock test method, file test method, which are specified in JIS H 8504, or by the following method.

In the case where purchaser requires, the following test may be carried out after heat treatment was applied as specified in Annex 4.

Punch test: Employing a center punch equipped with a spring, whose end point is polished to make 2 mm diameter ball, dent several points by about 5 mm interval, and adjust the adhesion observing the dents.

11.8 Porosity test Porosity test shall be according to Annex 5.

11.9 Test on corrosion resistance The test on corrosion resistance shall be carried out by any one of the following. Neutral salt spraying test, acetic acid acidic salt spraying test, CASS test, corrodokote test method, which are specified in JIS H 8502, or the method specified in Annex Table 6.

11.10 Wear resistance test Wear resistance test shall be carried out according to the test method specified in JIS H 8503.

11.11 Solderability test Solderability test shall be carried out by the following immersion method specified, or the method in **JIS C 0050**, or the method recognized effectiveness between the parties concerned with delivery.

- a) Coat a test piece with non-corrosive flux (for instance, alcohol solution of resin).
- b) Keep a solder bath at $25\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ in which H60A or H63A specified in **JIS Z 3282** or equivalent eutectic alloy was set, and immerse the test piece for 3 seconds.
- c) Take out the test piece, shake off slightly to remove superfluous solder, and allow it to cool in air.

Remarks: The number of days to allow it to stand after plating shall be agreed upon between the parties concerned with delivery.

12 Inspection Inspection shall be carried out as follows.

- a) Coatings are tested according to 11, and if the test results conform to the requirements in 5, coatings shall be judged to be acceptable.
- b) Test pieces shall be taken from the lot composed of the same parts according to **JIS Z 9031**.

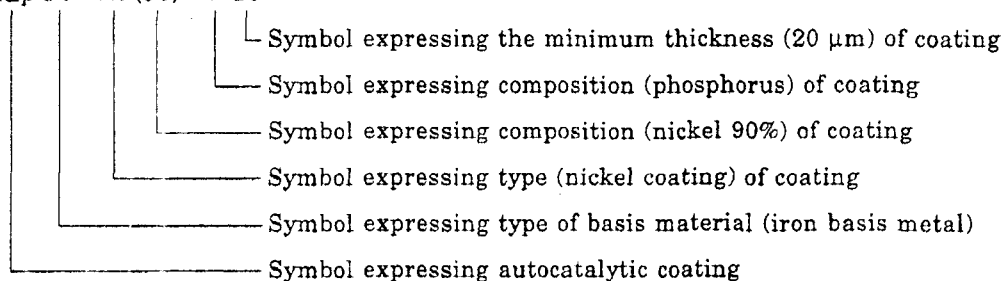
Remarks 1 The choice of test items and test methods shall be subjected to the agreement between the parties concerned with delivery.

2 The number of test pieces, ordering of inspections, target spot to be inspected, and use of substitute test piece, shall be subjected to the agreement between the parties concerned with delivery

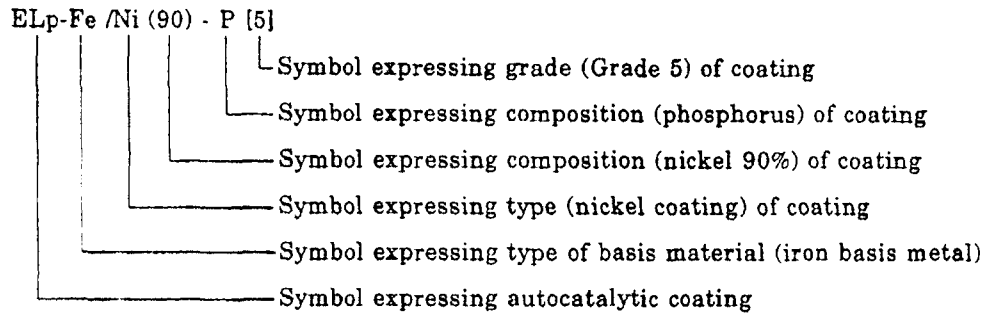
13 Designation of electroplated coatings The electroplated coating shall be designated in such ordering as, type of coating, basis metal, and the minimum thickness of coating or its grade.

Example: On basis metal of iron or steel, autocatalytic nickel-phosphorus coating with nickel (90 %) and phosphorus (10 %), 20 μm (or 5 grade) coating

ELp-Fe / Ni (90) - P 20



Example: On basis metal of iron or steel, autocatalytic nickel-phosphorus coating with nickel (90 %) and phosphorus (10 %), grade 5 (or 20 μm) coating



14 Marking The following information shall be given in on an invoice or delivery note.

- a) Symbol for coatings
- b) Year, month, and day of processing
- c) Name of plater
- d) Test results of coating qualities mentioned in an ordering note or process specification

15 Items to be described in an ordering note or process specification
Orderer shall supply the following information in the ordering note or process specification. Additional items, however, shall be omitted upon the agreement between the parties concerned with delivery.

a) Fundamental items

- 1) Properties and conditions of basis material
- 2) Symbol of coating
- 3) Significant surface of coating

Informative reference: It is preferable to indicate on the drawing or to present the actual sample with marking.

- 4) Appearance of coating

Informative reference: It is preferable to submit the boundary sample.

- 5) Method for inspection (for instance, the method for adhesion test to be employed)

b) Additional items

- 1) Required heat treatment

Informative reference: Any requirements for stress-relieving treatment before plating and/or hydrogen embrittlement reduction after plating.

- 2) Any requirements for the process to induce compressive stress

Informative reference: For instance, peening before plating.

- 3) Any requirements for, or restrictions on, pretreatment