Materials and Qualification Procedures for Ships

Book L

Procedure 15-2

Approval Scheme for Firms undertaking Electrolytic Processes

Revision 1, December 2013
Approval Scheme for Firms undertaking Electrolytic Processes

1. Introduction

1.1 Application for approval

1.1.1 In order that consideration may be given to approval of a firm undertaking thermal spray coating on components subject to LR classification, the local Surveyors are to submit a report to Materials and NDE Department, giving the information listed in Section 2 and the results of approval tests carried out under their survey.

1.1.2 Approved works will be subject to periodic inspection (see Procedure 1-1)

1.2 Scope

1.2.1 This procedure outlines the method of approving firms undertaking electrolytic plating on components subject to LR classification.

1.2.2 Electrolytic plating is acceptable to LR for the following purposes:

   (a) For wear or corrosion resistance as part of the initial design of the component.

   (b) For the rectification of dimensional errors in new components.

   (c) For the reclamation of certain wasted or worn machinery components.

Acceptance is in all cases subject to:

   (a) Plating being carried out by a firm approved by LR using a process that is suitable for the specific application.

   (b) Plating not being a means of making good a deficiency in tensile or torsional strength.

   (c) Machining in preparation for plating does not reduce dimensions below Rule requirements.

   (d) The owner being advised where it is proposed to use plating for the rectification of dimensional errors or for the reclamation of wasted or worn components.

   (e) Plating being carried out to the satisfaction of the attending Surveyor.
1.3 Acceptable types of electrolytic plating

1.3.1 Both traditional tank or bath plating and selective (brush) plating applications will be considered for approval. Electroless plating will not normally be accepted.

1.3.2 A broad range of elements and alloys can be deposited by electrolytic plating and acceptance of a specific deposit will be on a case by case basis. Chromium and nickel are the most widely used deposits for plating machinery components.

1.3.3 Test data available indicates, however, that chromium deposited on top of nickel plating causes a substantial reduction in the fatigue strength and this combination is not acceptable.

1.3.4 Chromium plating is compatible with most types of bearing metals but nickel plating should not be used with copper-lead or leaded bronze bearings.

1.3.5 The geometric form at the extremities of the plating is to be designed to minimize stress concentrations. Any undercutting in preparation for plating is to be finished with a radius as large as practicable and the edge of the plating is to be smooth finished to a good radius or taper.

1.3.6 For shafting, including crankshafts, the plating is to be stopped clear of the fillet radius. Any undercutting of the bearing surface to receive the plating is to be blended out not less than 2.5 mm from the point of tangency of the fillet radius. Where there is no undercutting of the bearing surface, a distance of not less than 1.5 mm between the edge of the plating and the point of tangency of the fillet radius is acceptable subject to satisfactory blending of the plating.

1.3.7 The plating is not to extend down the radius of oil holes for a distance greater than 0.6 mm measured radially from the bearing surface. In this region the edge of the plating can be hand finished.

1.4 Related Rules

1.4.1 LR’s Rules and Regulations for the Classification of Ships (hereinafter referred to as the Rules for Ships).

1.4.2 LR’s Rules for the Manufacture, Testing and Certification of Materials (hereinafter referred to as the Rules for Materials).
2.0 Information required for approval

2.1 The firm is to supply the following information:

(a) Name and address and brief statement of background indicating whether the firm is new or long established and experience in electrolytic plating.

(b) Details of the facilities and processes used for pre-plating preparation, plating and post-plating machining. This should include information on the types and maximum dimensions of machinery components that can be treated.

(c) Details of the precautions taken to minimize hydrogen embrittlement and availability of furnaces for hydrogen diffusion heat treatments.

(d) Facilities available, such as magnetic particle or dye penetrant testing, for examination of wasted or worn machinery components prior to plating.

(e) For tank/bath plating, details of the method used to control plating solution composition, strength and condition.

(f) Facilities available for testing the adhesion and quality of plated components. This preferably should include fluorescent dye penetrant testing equipment.

(g) Brief details of the quality control system established in the works including the calibration procedures for ammeters and voltmeters used to control the plating process.
3.0 Approval tests

3.1 Samples should be prepared for adhesion tests. These are required for each type of plating deposit for which approval is required.

3.2 The material used for the preparation of these samples should be similar to the material of the component to be plated. For steel components the test specimens should have a minimum tensile strength of ≤ 850 N/mm² and the surface to be plated should have a suitable ground finish.

3.3 After plating the adhesion tests should be carried out in accordance with BS EN ISO 2819 “Metallic coatings on metallic substrates – Electrodeposited and chemically deposited coatings – Review of methods available for testing adhesion”. The test to be used will be dependant on the type of plating. Generally, for deposits of nickel or chromium the ‘File test’ or ‘Thermal shock (quenching) test’ methods are preferred.

3.4 The File test consists of sawing a section of the plated test sample and applying a coarse file to the cut edge, filing from the base material to the plating and at an angle of approximately 45° to the plated surface. No detachment of the coating shall occur. This test is not suitable for very thin coatings.

3.5 The Thermal shock (quenching) test is carried out by heating the plated sample, or a section cut from this sample, to the appropriate temperature shown in Table 15-2.3.1, holding for one hour at this temperature followed by quenching in water at room temperature. No separation by blistering, flaking or exfoliation of the coating from the basis metal shall occur.

3. Table 15-2.3.1 – Thermal shock test temperature

<table>
<thead>
<tr>
<th>Basis metal</th>
<th>Plated deposit</th>
<th>Tin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chromium, nickel, copper and tin-nickel</td>
<td>300°C</td>
<td>150°C</td>
</tr>
<tr>
<td>Copper, copper alloys</td>
<td>250°C</td>
<td>150°C</td>
</tr>
<tr>
<td>Aluminium, aluminium</td>
<td>220°C</td>
<td>150°C</td>
</tr>
<tr>
<td>alloys</td>
<td>150°C</td>
<td>150°C</td>
</tr>
<tr>
<td>Zinc alloys</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.6 Surveyors should witness all stages in the plating of at least two typical machinery components. This should include dimensional checks before and after plating and careful visual examination after final machining which, if possible, should be supplemented by fluorescent dye penetrant testing.
4.0 Validity of approval certificate

4.1 The initial approval certificate will have a validity of three years.

4.2 For the validity to be extended for a further three years the Surveyors should undertake a periodic inspection in accordance with Procedure 1-1.