

# Zn-Ni Precoated Steel Sheets with Cr(VI)-Free Self-Lubricating Film\*

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## 1 Introduction

At the beginning in the second half of the 1980s, self-lubricating steel sheets which can be press-formed without oil coating were developed<sup>1-4)</sup> and are now widely used by electrical makers and auto parts makers. Kawasaki Steel produces River Zinc<sup>®</sup> FS series, which are self-lubricating steel sheets based on a pure zinc coating, with high reputation. Since the Zn-Ni alloy coating offers excellent corrosion resistance and an attractive appearance there is strong demand for self-lubricating steel sheet based on Zn-Ni alloy coated sheets.

A chromate treatment, which is used on conventional coated steel sheets, provides a self-healing effect of corrosion from scratched and other damaged areas. However, the chromate film contains Cr(VI), hexavalent chromium which is an environmentally unfriendly substance. For this reason, in Europe, "The Final Draft of a Directive on the Recycling of Waste Electrical and Electronic Equipment (WEEE)" has officially announced, that the use of Cr(VI) would be completely prohibited by the year 2007. Thus, development of a Cr(VI) free type coating is highly required.

In response to this requirement, Kawasaki Steel developed a chromate free type coating with better self-lubricating character than the conventional River Z<sup>®</sup> FS. This report describes the properties of the newly developed self-lubricating film.

## 2 Properties of Developed Material

### 2.1 Coating Structure

The coating structure of the developed steel is shown in Fig. 1. It features the following three points.

- (1) The coating contains absolutely no chromate.
- (2) Newly developed 4 μm thickness self-lubricating

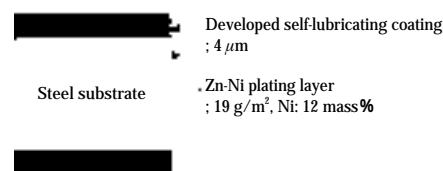


Fig. 1 Cross sectional view of developed self-lubricating steel sheet

Table 1 Specimens used in this study

Symbol	Type	Coating
Specimen A	Cr(VI)-free	Developed self-lubricating coating (4 μm)
Specimen B	Chromate	Chromate coating (Cr; 15 mg/m <sup>2</sup> ) + Conventional self-lubricating coating (4 μm)

film secure improved press formability, good appearance and corrosion resistance after forming.

- (3) Press forming without oil coating is possible in the same manner as with River Zinc<sup>®</sup> FS.

Table 1 shows the specimens used in the following evaluation. The developed material (hereinafter called specimen A) is a Zn-Ni alloy coated steel sheet (coating weight, 19 g/m<sup>2</sup>; Ni, 12 mass%), with the newly developed lubricating film. As a comparison material (hereinafter called material B), the same Zn-Ni alloy coated steel sheet with the River Zinc<sup>®</sup> FS lubricating film (film thickness, 4 μm) with a conventional chromate (Cr, 15 mg/m<sup>2</sup>) is used.

### 2.2 Lubricity

Figure 2 shows the coefficient of friction in a flat sliding test using various holding pressures between 20~80 MPa. The coefficient tended to decrease with the increase in the holding pressure. At all holding pressures, the coefficient of friction of specimen A was lower than that of specimen B. In particular, when a

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