※Quality improvements in place since April 2006

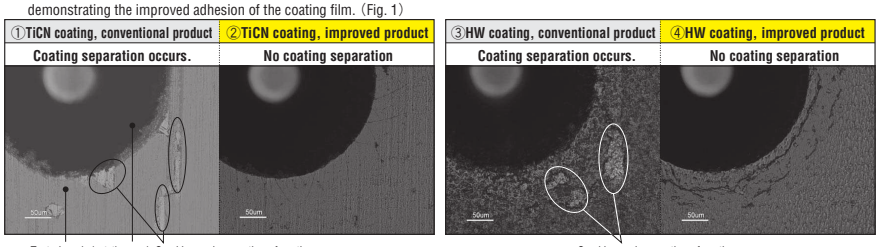
■Introduction

In recent years, there has been growing use of high-tensile steel sheet in the automobile industry due to increasing worldwide demands for weight reduction and higher safety performance.
The punching conditions for high-tensile steel sheet become increasingly severe year after year, leading to problems of early wear and chipping. Consequently, there is much interest in increasing the life spans of the punches.
So-called "coating punches" with improved coating adherence and wear resistance have been commercialized in order to solve these problems. These improved coating punches have much longer life spans than conventional products.

■Features of improved coating punches

■Better adhesion of the coating film

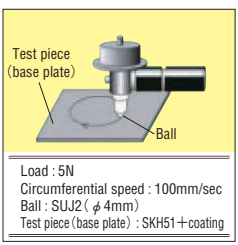
Unless the coating film adheres strongly to the base material, the film will quickly separate due to external stress despite its excellent coating properties. Accordingly, in order to evaluate the adhesion force of the film, indentation tests using a Rockwell hardness tester (C scale) were performed, and the conditions of film separation were observed.
The tests showed that while coating separation and cracking occurred in the conventional product, separation did not occur in the improved product, demonstrating the improved adhesion of the coating film. (Fig. 1)



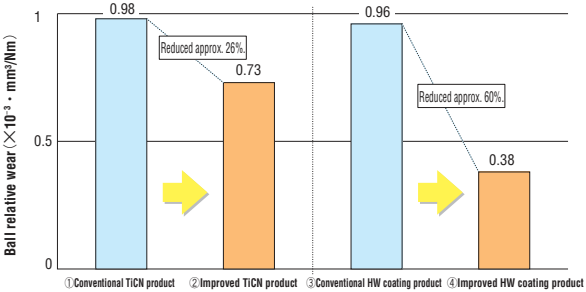
(Fig. 1) **Results of observation after indentation test** (test piece material: SKH51)

■Improved wear resistance

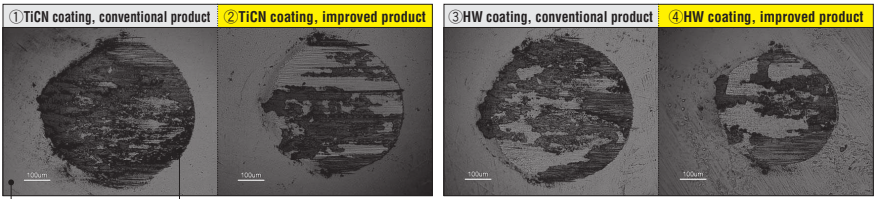
One cause of punch wear is adhesive wear in which the workpiece and punch stick together, causing wear of both parts.
In order to evaluate the wear resistance, a friction wear test was carried out and the relative wear of the ball was measured.
Here, the test piece (base plate) simulates the punch and the ball simulates the workpiece (Fig. 2), and the relative wear of the ball was measured in order to determine the superiority or inferiority of the wear resistance.
Compared to the conventional product, ball relative wear fell by approximately 26% when a TiCN coating was used, and by approximately 60% when an HW coating was used. (Fig. 3)
This test also shows that the improved product ball has a smaller friction surface (Fig. 4) and better wear resistance than the conventional product.



(Fig. 2) **Overview of friction wear test**



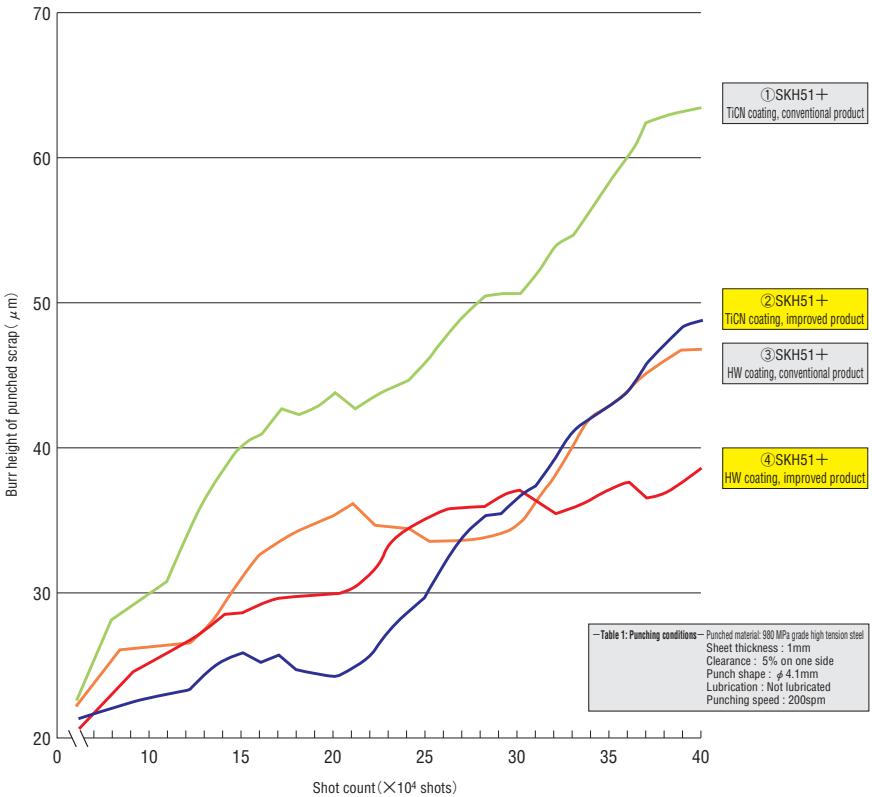
(Fig. 3) **Relative wear of ball after friction wear test**



(Fig. 4) Ball friction surface after friction wear test

■Punching life span test with 980 MPa high-tensile steel

A punching life span test using 980 MPa high-tensile steel was carried out, and the burr height of the punching scrap was measured (Fig. 5).
(Test conditions: Table 1)
If the maximum allowable burr height is assumed to be 50 μm, the improved TiCN coating product can be used for a minimum of 1.5 times the number of shots as the conventional product.
A comparison of the burr height after 400,000 shots shows that the improved HW coating product produces scrap with the smallest burr height, and also that this punch has the highest durability of the coating punches used in this punching test.

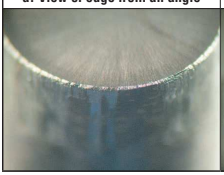
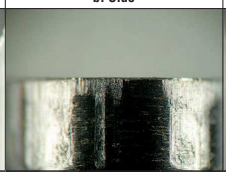
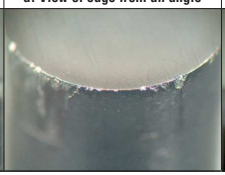
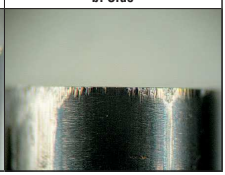


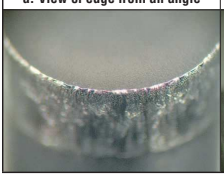
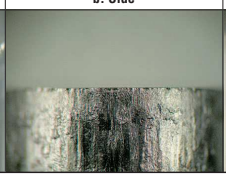
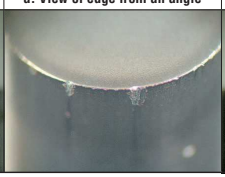
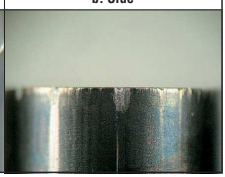
(Fig. 5) Changes in burr height with increasing shot count

■Comparison of tip and side appearance at a punching life span test using 980 MPa high-tensile steel

When the appearance of the tips was compared after a punching test (400,000 shots) using 980 MPa high-tensile steel (Fig. 6), separation of the coating film and seizure were found on the tip of the conventional product. Also, there was chipping and wear of the edges over a broad area.
On the other hand, while separation of the film that was thought to be the result of edge chipping was found on the improved TiCN coating product, no seizure was found on the tip or side, and the tip remained in generally good condition after the test.
No chipping or seizure at all was observed on the improved HW coating product, demonstrating that good coating film conditions were maintained.
It is believed that the WPC© treatment contributes to improved fatigue strength of the punch tip. (※For details concerning the WPC© treatment, refer to P. 1095.)

From the above results, it was confirmed that the improved product is highly effective even with materials that are difficult to machine, such as 980 MPa high-tensile steel.

①TiCN coating: Conventional product		②TiCN coating: Improved product	
a. View of edge from an angle	b. Side	a. View of edge from an angle	b. Side
			

③HW coating: Conventional product		④HW coating: Improved product	
a. View of edge from an angle	b. Side	a. View of edge from an angle	b. Side
			

(Fig. 6) Appearance of the tip after the punching life span test (400,000 shots) using 980 MPa high-tensile steel

Reference: List of punches for which improved coating products are available

Improved punch	M	TiCN coating: Improved product		HW coating: Improved product	
Shoulder punch	SKH51	●	P. 51	●	P. 53
	Powdered high-speed steel	●		●	
Jector punch	Powdered high-speed steel	●	P. 61	●	P. 63
Jector punch (spring-reinforced type)	Powdered high-speed steel	●	P. 61	●	P. 63
Shoulder quill punch	SKH51	●	P. 71		
	Powdered high-speed steel	●			
Shoulder short punch	SKH51	●	P. 73		
	Powdered high-speed steel	●			
Key flat shank shoulder punch	SKH51	●	P. 79	●	P. 81
	Powdered high-speed steel	●		●	
Key flat shank jector punch	Powdered high-speed steel	●	P. 83	●	P. 85
Key flat shank jector punch (spring-reinforced type)	Powdered high-speed steel	●	P. 83	●	P. 85
Punch with locating dowel hole	Equivalent to SKD11	●	P. 91	●	P. 93
Jector punch with locating dowel hole	Equivalent to SKD11	●	P. 99	●	P. 101
Jector punch with locating dowel hole (spring-reinforced type)	Equivalent to SKD11	●	P. 99	●	P. 101

Improved punch	M	TiCN coating: Improved product		HW coating: Improved product	
Punch for heavy load	SKH51	●	P. 107	●	P. 109
	Powdered high-speed steel	●		●	
Jector punch for heavy load	Powdered high-speed steel	●	P. 117	●	P. 119
Jector punch for heavy load (fixed B type)	Powdered high-speed steel	●	P. 125	●	P. 127
Tapered head punch	SKH51	●	P. 129	●	P. 129
	Powdered high-speed steel	●		●	
Tapered head jector punch	SKH51	●	P. 131	●	P. 131
	Powdered high-speed steel	●		●	
Punch for heavy loadwith dowel hole	SKH51	●	P. 135	●	P. 137
	Powdered high-speed steel	●		●	
Jector punch for heavy loadwith dowel hole	SKH51	●	P. 141	●	P. 143
Tapped punch	SKH51	●	P. 149 P. 157	●	P. 151
	Powdered high-speed steel	●		●	
Punch with key groove	SKH51	●	P. 161	●	P. 163
	Powdered high-speed steel	●		●	
Straight punch	SKH51	●	P. 170		
	Powdered high-speed steel	●			

※The above punching test used an ISIS 20-ton precision press and precision progressive dies. With actual dies, because a broad range of factors including press accuracy and variation in clearance accuracy are involved, it is expected that wear will occur earlier than in this punching test. Please use the results here as reference data.