Innovations in Tinplate Differential Marking Equipment

Enhancements and modifications have been made to differential printers for tin mill products. These enhancements lower costs and improve print quality, product yields and worker safety.

The identification of products has been around nearly as long as have products themselves. Since ancient times, craftsmen and manufacturers alike identified their product with their initials or unique logo.

The primary metals industry is no different. Traceability and product liability are the main drivers for current cradle-to-grave product identification standards, including modern bar coding and techniques.

Tin mill products present a unique identification application, in that coils differentially coated must be marked on either the heavy side or the light side as per ASTM A624/A624-M.[1] The latest innovations in the operation and maintenance of differential tinplate printers will be presented.

Differential Tinplate Printers

Differential tinplate printers are designed to print either parallel lines or geometric patterns on tinplate to designate both the heavy- and light-coated sides of the strip. Fig. 1 presents a differentially coated tinplate sheet, printed with parallel lines on the heavy-coated side.

Some of these printers have been in operation for over 30 years (Fig. 2). The original differential tinplate printers incorporated three rolls: a pickup roll, a transfer roll and a die roll (Fig. 3). The printing solution, usually sodium dichromate, is pumped to a manifold to a series of spray nozzles and then deposited onto the pickup roll. The pickup roll is rubber coated and acts as a squeegee to remove any excess printing solution from the smooth surface of the transfer roll. The transfer roll conveys the solution to the die roll, which contains a set of die bands for printing the specific line pattern. When the pattern needs to be changed, the die roll must be removed and replaced with another with the proper pattern. This process is time consuming and sometimes leads to a large inventory of die rolls.

Over the past decade, a series of enhancements and modifications has been made to maximize the efficiency of existing differential coating printers. The aims of these enhancements were to:

- Lower the cost of materials needed to change print patterns.
- Reduce the amount of time required to change print patterns.
- Reduce the amount of time required to bring printers back into proper printing position after print pattern changes.
- Improve print quality by eliminating trial and error from manual print pressure adjustments.
- Increase the speed of print pattern changes through automation.
- Improve worker safety.

Figure 1

View of a highly reflective tinplate surface, differentially marked on the heavy-coated side.

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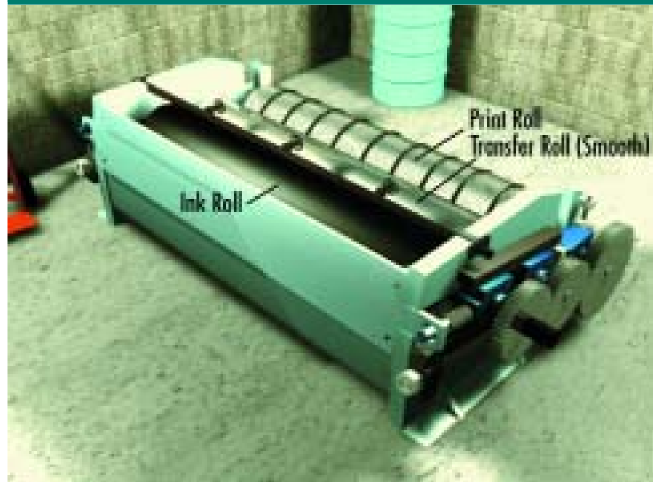
Figure 2

View of an original differential tinplate marker in service.

Figure 3



View of a 3-roll differential tinplate marker, showing the pickup (ink) roll, transfer roll and die (print) roll.

Three major improvements have been instituted or are being developed and are discussed below.

Wick Board Conversion

A wick board (Figs. 4 and 5) is a fiberglass board holding a number of wicks (fabric rings or felts) that are responsible for transferring the printing solution (normally sodium dichromate) to the printing roll surface. The printing solution is transferred to the printing roll surface or dies only where felts are in place. By changing the number and position of the wicks on the board (or by exchanging preset wick boards), the operator can quickly change print patterns. When used with a print roll that contains a full set of individual printing dies, the wick board assembly eliminates the need to exchange entire print rolls to change the print pattern.

The wick board can be used with either a print roll containing individual die bands or with rubber-covered print rolls that are individually engraved with a specific pattern. The most economical method is to use the wick board assembly with a print roll containing individual rubber die bands. This offers a number of advantages. If a single die band is damaged, it can be easily replaced, and, more importantly, a complete set of die bands is much less expensive than a new engraved, rubber-covered roll.

The low weight of the wick board (approximately 15 pounds) allows for fast, easy changes. The low cost of the wick board and wicks makes the system an attractive solution compared to the expensive alternative of stocking print rolls and changing complete print rolls for every print pattern change (Fig. 6).

The wick board features a quick-change assembly to vary the marking to be printed. This assembly makes it unnecessary to

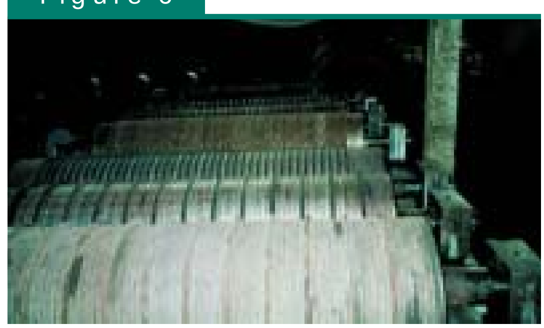
Figure 4

View of a wick board.

Figure 5

View of a wick board frame.

Figure 6



View of inventoried die rolls with different patterns for a traditional marker.

Figure 7

Steps involved in replacing the pickup roll with a wick board assembly: (a) before conversion; (b) pickup and transfer rolls prepared for removal; (c) pickup and transfer rolls being removed; (d) new transfer roll with raised lands; (e) new transfer roll installed; (f) wick board assembly installed; (g) view showing easy removal of wick board; and (h) view showing the use of multiple wick board patterns.

Table 1

Cost Savings of a Wick Board Versus Engraved Rolls

Product	Unit cost	Number required for one year of operation	Total cost
Engraved rubber print rolls: 10 engraved rubber rolls (10 print patterns) with an operational life of one year	$6000	10	$60,000
Die bands: Die band sets must be changed three times per year	$1500 per set	3	$4500
Wick boards and felts: A set of 10 wick boards, complete with wicks (10 print patterns), with an operational life of one year	$2000 per set	10	$20,000
Savings:			**$35,500**

remove die bands or change printing rolls to alter the marking. The printer conversion can be accomplished on-site, as it involves removing the pickup roll and replacing it with the wick board assembly (Fig. 7).

Production Advantages of the Wick Board Conversion — The wick board configuration allows print patterns to be changed in minutes. It is estimated that changing a wick board assembly saves approximately 20 minutes over changing an engraved print roll.

Print quality is also improved. Engraved rubber rolls that are easily damaged or do not meet original equipment specifications can be eliminated.

Cost Advantages of the Wick Board Conversion — Table 1 presents the cost savings when using wick boards and one printing roll with die bands in comparison to having a set of engraved, rubber-coated print rolls.

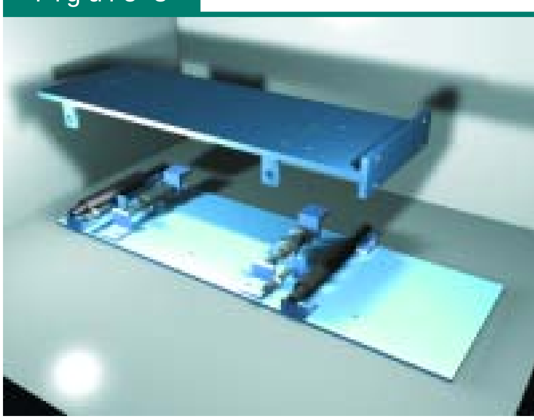
Remote Positioning System

The remote positioning system is an arrangement of pneumatic controls allowing operators to quickly and accurately put the printer back into the correct printing position after it has been taken off-line. Four air cylinders are regulated from either of two control panels, with one station located at the printer and the other located either at the operator's control pulpit or an inspection station.

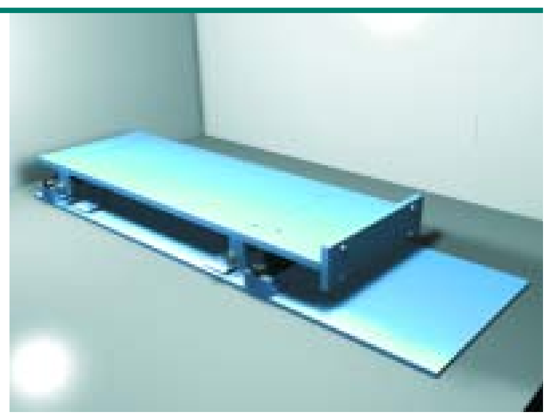
In this system, the differential tinplate printer is mounted on a skewing base (Fig. 8) that permits the printer to be moved toward and away from the strip for maintenance and print pattern changes. Two independent air cylinders control the movement of the skewing base, which is mounted on roller bearings, and they control the pressure distribution of the printer against the strip.

The remote positioning system modification (Fig. 9) also replaces the original, manually adjusted screws with two independent air cylinders for controlling pressure distribution between the transfer roll and the die roll.

Figure 8



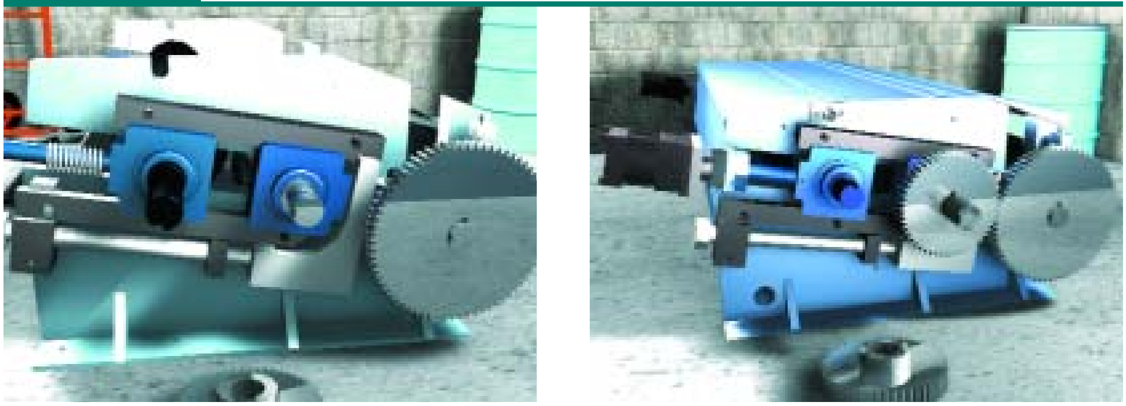
(a)



(b)

Views of the skewing base: (a) expanded and (b) as assembled.

Figure 9



(a) (b)

The remote positioning system replaces (a) manually adjusted screws with (b) air cylinders to control transfer roll pressure.

Installation requirements for the remote positioning system are:

- The printer must allow for the adjustment of pressure between the transfer roll and the printing roll.
- The skewing base must be equipped with a ball bearing design. Skewing bases that can be adjusted only manually via screw adjustments are not suitable for use with a remote positioning system.

If an installation has more than one printer, additional units can be outfitted with adapter kits that will allow them to be used with the remote positioning system.

With these controls, the remote positioning system virtually eliminates guesswork from print adjustment by quantifying the printer position settings while simultaneously enabling the operator to adjust the print pattern. Moreover, the remote positioning system shortens print changeover time, reduces scrap and eliminates reliance on highly specialized or experienced personnel.

Remote Print Control System

The remote print control system allows operators to remotely select print patterns through a system of electronically controlled valves. The system eliminates the need to make physical changes to printers, such as changing print rolls or wick boards, and it eliminates taking printers off-line for changes. In other words, print patterns can be selected on the fly. This system is designed for parallel line printing patterns only, and only for use in printers that have wick boards and transfer rolls with lands.

The system consists of 12 manifolds, with each manifold containing eight spray nozzles. The nozzles are controlled through an operator interface so that print pattern changes can be made on the fly. This system is currently under development; however, Fig. 10 presents a single eight-nozzle manifold on a scale model of a differential tinplate printer. Tests on a laboratory scale have proved successful, and a full-scale production unit will be operating in early 2004.

Figure 10

(a) (b) (c)

Views of a laboratory-scale remote print control system.

Summary

A series of enhancements and modifications has been made to maximize the efficiency of existing differential coating printers. These enhancements lower costs and improve print quality, product yields and worker safety.

Acknowledgment

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Reference

1. "A624/A624-M-98, Standard Specification for Tin Mill Products, Electrolytic Tinplate, Single Reduced," ASTM International, West Conshohocken, Pa.

AISE

LATEST ADVANCED HIGH-STRENGTH STEEL FROM U. S. STEEL ENTERS PRODUCTION

Automotive customers of U. S. Steel Corp. are evaluating and qualifying the company's new hot dipped galvanized DUAL-TEN 780 product for structural applications. Commercial quantities of DUAL-TEN 780 are now available in a range of thickness from 1.0 to 2.0 millimeters and in widths up to 1370 millimeters.

One customer has already successfully produced parts from trial quantities of 1.0- and 1.2-millimeter dual-phase galvannealed sheet having a minimum tensile strength of 780 MPa. The company also provides hot dipped galvanized DUAL-TEN 600 for the recently launched General Motors 2004 Chevrolet Malibu.

U. S. Steel was the first American steelmaker to develop and commercially produce a family of dual-phase steels, trademarked DUAL-TEN. These steels are engineered to meet the demands of automakers for high-strength, lightweight materials with improved formability that will help them reduce vehicle weight and cost while improving crash safety performance.

Dual-phase steels offer an exceptional combination of strength and formability. Their high ductility is due to a microstructure consisting of a fine dispersion of hard martensite particles in a soft ferrite matrix. These grades have a high strain hardening capacity, enhancing strain redistribution and thus providing good formability. Work hardening during forming also increases the yield strength in finished parts to much higher strengths than in the initial blank. The combination of high strength and ductility and the capacity for strain hardening leads to excellent fatigue properties and good energy absorption characteristics, making these steels suitable for structural and reinforcement components. These properties can be enhanced further by marked strain hardening combined with a pronounced bake-hardening effect, offering an excellent potential for weight savings in structural parts.

U. S. Steel also introduced hot rolled 590SF for high-strength applications requiring stretch flanging, especially at circular holes. The commercially available steel is being used to replace castings for applications in control arms and suspension members.