



ENVOY

AUGUST, 2003

Message from the Managing Directors

The last six months have seen exciting extensions of R&D efforts and experience in a number of technical areas, including thin strip casting, interaction of batch annealing and coiling operations, hot mill setup technology and new thickness control techniques. A number of these are about to be published in the AISE Steel Technology journal and will be presented at the September AISE Annual Convention.

Our objective in performing this work is to enhance the performance of our automation systems and of those already installed in client sites. A good example of this was the impact of installing hot edge sprays and the IAS single stand setup model on the six-high cold mill at Norandal USA Inc, Huntingdon. The speed increase on final passes and the throughput improvement were each increased by more than 40 percent.

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A BUSY SIX MONTHS:

During the past two years we have seen scrap prices rise, energy costs increase, metals prices drop, and margins decrease. These conditions, combined with other market woes, present the metals industry with quite a bleak outlook.

IAS has been fortunate during 2003 to win a respectable number of contracts for automation systems and consulting contracts. These, in addition to existing contracts from 2002, have kept our engineers quite busy over the past six months. The IAS commissioning and consulting engineers have ventured far and wide across Asia, North America and Australia and been involved in every aspect of our business.

Here is a sample of the work undertaken.

As has been our experience during previous depressed market conditions, IAS has drawn on the process knowledge and expertise of it's staff to provide innovative performance and productivity improvements that can be achieved in a very cost sensitive environment.

Hydraulic Gap and Thickness Control	Alcan Tahan Aluminum, South Korea
	Alcan, Oswego, NY
	Ormet, Hannibal, OH
Automatic Flatness Control	Norandal, Huntingdon, TN
	Ormet, Hannibal, OH
	Weirton, WV
Adaptive Mill Setup (hot mills)	BHP Steel, Western Port, Vic
	Panzihua, China
Adaptive Mill Setup (cold mills)	Norandal, Huntingdon, TN
	Panzihua, China
Mill Audits / Studies	CSI, Pittsburg, CA
	Elgiloy Specialty Metals, Hampshire, IL
	Rouge, Dearborn, MI
Consulting & Analysis Software	AK Steel, Rockport, IN
	BHP Steel, Port Kembla & Western Port
	Corus LP, Canada
	Hysa, Mexico
	ISCOR Saldanha Steel, South Africa
	ISG, Indiana Harbor, IN
	Nucor, Berkeley, SC & Crawfordsville, IN
US Steel, East Chicago, IN	

THEORY OF HEADS & TAILS:

An important performance measure of hot and cold rolling mills is the material, which has to be cropped off the coil head and tail ends because it fails to meet the desired thickness tolerances.

Typically the sum of these end lengths may be between 0.5 and 3.0 percent of the total coil length, a significant production cost. Thickness errors arise as a direct result of the lack of tension on the exit or entry side of each stand as it threads or de-threads respectively at the coil ends.

The dilemma is that as one attempts to shorten the end losses by more aggressive control system tuning other problems arise, which impact on the ease of threading coil ends. The quality of the feed material also affects the thickness control performance. A detailed investigation by IAS research staff has analysed the impact of threading tensions on the thickness errors and disturbance lengths.

To gain a basic appreciation of the tension induced disturbance on the strip head end, it is useful to consider the mechanics of threading a stand. Initially there is no entry tension for a very short time (typically a few hundred milliseconds) and no exit tension until the next downstream stand is threaded. The presence of tension reduces the roll force required to achieve a given thickness reduction, or, conversely, for a given force, the lack of entry or exit tension will reduce the reduction (ie increase the exit thickness).

In practice it is more common to maintain a fixed rollgap position for the threading of the head end than to control the roll force to be constant. This results in small force variations in response to the tension and thickness changes, which accumulate as the headend progresses from the first to the last stand.

Whereas the first stand threaded has the nominally correct entry thickness and an exit tension disturbance, each of the subsequent stands has an entry thickness disturbance due to the upstream stand tension effects as well as its own exit tension disturbance.

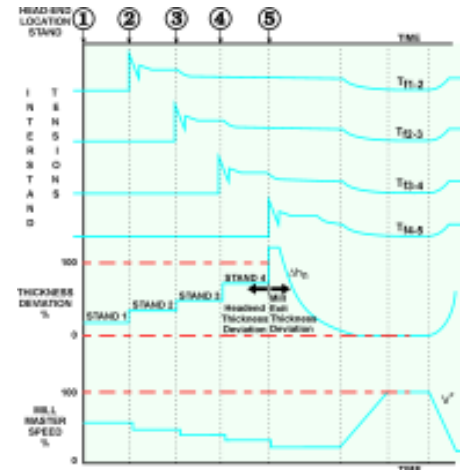


Fig.1 Schematic Thickness & Tension Threading Transients for Tandem Cold Mill

The propagation of these disturbances is shown schematically in Fig.1, for a tandem cold mill with a constant head end threading speed and rollgap positions set to the correct value for the situation when tension is established on each side of the stand.

The thickness errors are plotted as percentages of the nominal thicknesses and may be seen to grow to a high figure at the exit of the last stand.

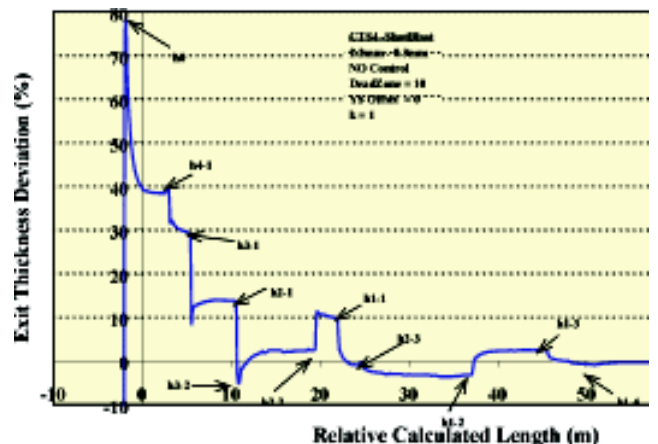


Fig.2 Simulation of Threading Thickness Trace at the Mill Exit of a 5 Stand 2000mm Cold Mill

THEORY OF HEADS & TAILS: (CONT'D)

As rolling continues the tension induced transients decay and the nominal thicknesses are achieved at each stand exit.

where L_{1-2} is the distance between stands 1 and 2, h_1 and h_5 are the nominal thicknesses at stands 1 and 5 respectively, and Δh_5 is the percentage thickness increase on the threaded headend. The constant k is an empirical constant, whose value is approximately 0.3.

Table 1 Amplitude of Tension Disturbance Induced Thickness Deviations at Each Stand During Threading

Symbol	Stand 1		Stand 2		Stand 3		Stand 4		Stand 5	
	Amplitude (%)	Spike (%)	Amplitude (%)	Spike (%)	Amplitude (%)	Spike (%)	Amplitude (%)	Spike (%)	Amplitude (%)	Spike (%)
h1	7.7	-	17.5	64	29	60.5	36.5	82.5	39	79
h1.1	11	-	18	-	10	-	10.5	-	18.8	-
h1.2	3.3	-	3.5	-	3.3	-	3.3	-	5.5	-
h1.3	3.2	-	3	-	3	-	3.3	-	3.2	-
h1.4	1	-	0.7	-	0.8	-	0.8	-	0.8	-
h2.1			19	26.5	15	21	15	21.8	15	18.5
h2.2			8	11.5	11	15	11	14	11	12.3
h2.3			2.5	-	2.7	-	2.2	-	2	-
h3.1					15.6	32	15.8	25.4	15.4	21
h3.2					3.7	-	3.3	-	4	-
h4.1							10.6	-	10.5	-

The mill behaviour was also simulated when threading tensions were controlled, either by stand speed or by downstream rollgap with varying input error deadzones. (See

A dynamic computer simulation of the detailed behaviour for the threading of a 2.2mm strip, 1000mm wide, rolled to a thickness of 0.3mm is shown in Fig. 2. This shows the thickness at the mill exit. Features of the thickness trace caused by tension transients at the various stands are shown by the code "hi-j" where "i" refers to the particular stand exit where the error was originally generated and "j" is the number of stands downstream where the threading tension transient was initiated. For example, h2-1 is the thickness change created at the exit of stand 2 when the strip headend threaded into stand 3. The thickness changes at each stand are summarised in Table 1.

It is now appropriate to consider the amount of product at the mill exit, which is affected by the tension induced transients.

The mass of disturbance affected material can be calculated easily since it is the mass of strip rolled through the first stand at the instant when the tension is established between the first two stands. From this mass the approximate corresponding length L_5 of strip at the mill exit is given by:

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$$L_5 = L_{1-2} h_1 / [h_5 (1 + k \Delta h_5 / 100)]$$

Control Deadzone (%)	CONTROL TYPE							
	Tension Control by Speed				Tension Control by downstream Rollgap			
	Headend		First Time		Head End		First Time	
	Tolerance (%)							
	1.0	3.0	1.0	3.0	1.0	3.0	1.0	3.0
	Length (m)							
0	38	21	19	19	43	40	8	8
10	35	20	20	19	48	40	13	8
20	41	19	11	10	48	25	8	8
30	46	32	11	11	-	-	-	-

Table 2 Headend Lengths with Controlled Tension

Table 2). The classified headend lengths were determined for two tolerances: 1.0 percent and 3.0 percent.

The determination of the lengths used the two definitions shown in Fig 3.

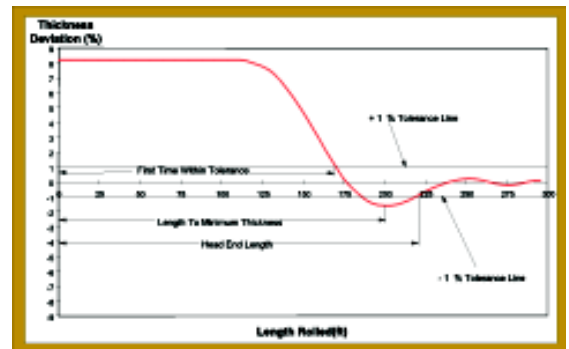


Fig.3 Definition of Headend Lengths

In practice the effects of input feed thickness and hardness disturbances may increase the lengths. Tailend lengths can be determined in a similar way and are typically 70 percent of the headend lengths.

GROWING ASIAN MARKET:

The metals sectors of the North Asian economies have done better than certain other parts of the world in recent times and IAS currently has two important projects running in China and one in the Republic of Korea.

IAS is supplying a thickness control (HGC / AGC) system for the Alcan Taihan Aluminum 2 stand cold mill in Yeongju, South Korea. On-site commissioning of this system has been completed and remote fine-tuning of the system from IAS offices in Australia is nearing completion.

Commissioning of the setup model for the Panzhihua tandem cold mill is in progress as this edition of Envoy goes

to press. The first group of engineers from the Panzhihua hot mill and ARIM (pictured below) visited Australia in January for design discussions. The second group is currently in Australia for training on the setup model for the finishing mill and the factory acceptance test for the system.



IRTC:



22nd International Rolling Technology Course
21st to 26th September 2003
Vancouver, CANADA

STAFF:

Last month we welcomed home Sales Manager, **Peter Steigler**, who has spent the past 2 years working in the IAS Pittsburgh office. His young children are currently enjoying celebrity status at school with their strong American accents.

Evan Spalding BE (Hons 1) Comp. Eng., joined IAS as a Software Engineer in July. Evan has experience in control systems for water, gas and oil industries as well as working on the integrated avionics system support facility



upgrade project for the F/A-18 Hornet aircraft.

Secretary, **Leanne Smith**, who has been with IAS for the past 7 years, gave birth to Lachlan, on 27th May. *Congratulations* go to Jeff and Leanne on the birth of their first child.

Many of you will know **Gary Boulton**, from his R&D work and as part of the IRTC team. Gary, Kara and their son, Callum welcomed baby daughter, Levani, on 11th July. *Congratulations.*



INDUSTRIAL AUTOMATION SERVICES

PO Box 3100, Teralba NSW 2284 Australia
Phone: +61 2 4965 8688 - Fax: +61 2 4965 8633
e-mail: info@indauto.com.au - Web: www.indauto.com.au

7000 Industrial Blvd., Aliquippa PA 15001 USA
Phone: 724 375 5500 - Fax: 724 375 7700
e-mail: info@indauto.com