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# NOVELIS HIGH-SPEED CAN END COATING LINE – OPERATIONAL RESULTS

Anthony Tropeano[1], Trajano Roque Neto[2]

[1] FATA Hunter; S.S. 24 km 12; Pianezza (TO), 10044, Italia
[2] Novelis; Av. Buriti, 1087 Feital - Pindamonhangaba - SP, Brazil

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## Abstract

As part of a large investment plan, Novelis, world leader in aluminium rolled products, has installed and commissioned at their facilities in Pindamonhangaba (São Paulo State) a new High Speed Single Coat (double faces) Coil Coating Line for Aluminium Coated End Stock.

The line was supplied by FATA Hunter, Division of FATA S.p.A. (Italy) and started commercial operations in the second semester of 2014.

The line, operating at 300 m/min, is capable of producing painted coil of 0.18 – 0.35 mm thick and 1,250 – 1,780 mm wide aluminium strip for production of Can Stock for the beverage industry.
The most advanced technologies were utilized in the design of the individual equipment, and their integration in continuous high quality and process control allow the production of superior coated end stock coating for the beverage industry.

## Introduction

Aluminium strip can be surface treated and coated to provide a variety of protective, decorative, or special-property finishes making it an ideal material for a wide range of applications.

The application of coatings to continuous coils is an industrial process since more than 50 years [1,2,3].

Coil coaters are always looking to increase their volume through the line. The overall line speed is limited by the time spent in the paint/lacquer curing ovens. Time at temperature is required to cure the organic film and also extreme care must be taken in balancing the coating line's fume exhaust system with the coating's solvent emission volume.

In coil coating for can end stock relatively thin lacquers are applied to aluminium. Utilizing advances in line design and lacquer formulations, some lines are now operating at speeds above 250 m/min [4].

On May 1st 2014 FATA Hunter and Novelis commissioned the new Coil Coating Line supplied by Fata Hunter to Novelis do Brasil Ltda. for the plant of Pindamonhangaba (State of Sao Paulo).

The line, operating at 300 m/min, is allocated to the painting of aluminum foil stock for the production of cans.


Figure 1. 1st painted coil on May 1st 2014.

Production of the 1st coated coil was achieved exactly 24 months after the signature of the Agreement with Novelis and in compliance with the implementation programs which had been agreed upon with the Company. All major commissioning tasks are complete.

## General Technical Data Of The Coil Coating Line

This is a state-of-the-art line that includes FATA Hunter patented single slide coaters for the best paint thickness accuracy.

Reliable strip tracking and strip tension control is achieved throughout the line by means of the proper number and configuration of bridle units and steering units, thereby limiting strip edge damage, strip breakage, telescoping finished coils and equipment abuse, while promoting higher coating uniformity and better product flatness.

Tension bridle rolls, steering rolls and accumulator rolls are polyurethane covered to prevent strip marking and assure proper friction coefficient between the rolls and the strip.

A quick change design is featured on the spray bars, squeegee rolls and the coater rolls.

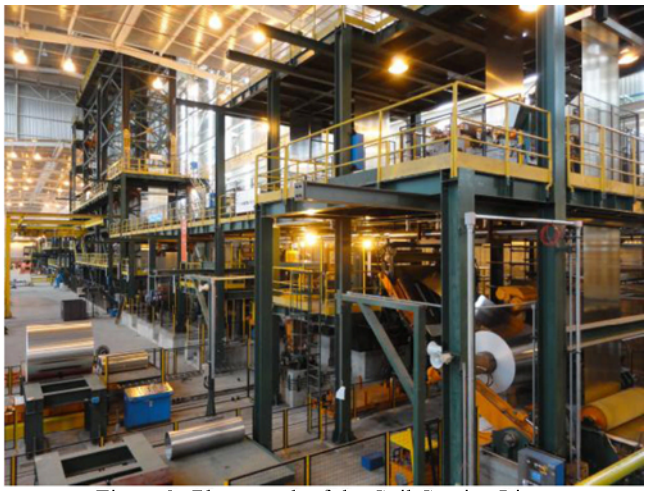

Figure 2. Photograph of the Coil Coating Line.

The line speed is as follows:

- Entry Section 100 - 400 m/min
- Process Section 100 - 300 m/min
- Exit Section 100 - 400 m/min

The incoming material consists of cold rolled aluminum alloys strips, wound in coils, always with spool.

| TABLE I. Incoming material | |
|---|---|
| Width [mm] | 1,250 - 1,780 |
| Thickness [mm] | 0.18 - 0.35 |
| Maximum coil external diameter [mm] | 2,400 |
| Maximum coil weight (spool not included) [kg] | 15,000 |
| Maximum strip surface oil (per side) [mg/m$^2$] | 30 |

The final product is a single coated, one- or two-side coated strip, wound in coil, always with spool.

| TABLE II. Final product | |
|---|---|
| Width [mm] | 1,250 - 1,780 |
| Thickness [mm] | 0.18 - 0.35 |
| Maximum coil external diameter [mm] | 2,400 |
| Maximum coil weight (spool not included) [kg] | 15,000 |
| Intended usage | Can End and Tabs Stock |
| Spool #1 material | Fiberglass |
| Spool #2 material | Cardboard |
| Spool #3 material | Aluminium |
| Strip flatness | ≤ 5 I-units |
| Coil side wall telescope | max 5 mm, total<br>max 1 mm, wrap to wrap |
| Coating types | Water or solvent-based coatings |
| Coating weight ranges [g/m$^2$] | Top side, dry:1-16 g/m$^2$<br>Bottom side, dry:1-16 g/m$^2$ |

**General Description Of The Coil Coating Line**

The coils, with spool, are loaded onto the Entry Coil Stands by the overhead crane. The Entry Coil Cars, equipped with traversing and lifting motion, pick the coils up and automatically load them onto the collapsible type Payoff Reels. In this area, coils will rest and will be handled with contact on the outer diameter.

Scrap elimination from the incoming coils is done at each Payoff Reel, without affecting the normal operation of the line. While the No. 1 Payoff Reel is feeding the strip into the line, a coil is loaded onto No. 2 Payoff Reel. The leading edge of the strip is fed (using the jog function) through the No. 3 Pinch Roll to the No. 2 Entry Shear (guillotine type). The operator will then operate the shear and advance (jog) the strip as required to completely eliminate the scrap material.

When loading the coil on the No. 1 Payoff Reel the sequence is similar, with the strip being fed through the No. 1 Pinch Roll to the No. 1 Entry Shear. When the running coil is almost depleted, the Entry Section will be stopped (upon request by the operator or automatically) and the strip is sheared at the No. 3 Entry Shear. The trailing edge of the running strip is then advanced to the Strip Joiner and, at the same time, the scrap portion is wound on the relevant Payoff Reel. The scrap portion can be cut in pieces at the No. 1 or No. 2 Entry Shear (as described for the head scrapping above), or the pup coil can be discharged onto the No. 1 / No. 2 Entry Spool Rack using the No. 1 / No. 2 Entry Coil Car.

When the space between the No. 4 Pinch Roll and the No. 3 Entry Shear is clear, the leading edge of the stand-by coil is advanced to the Strip Joiner, where splicing with the previous strip occurs. Prior to splicing, the leading edge of the new strip is aligned and centered to the trailing edge of the previous strip. After the splicing operation is completed, tension is applied to the strip and the Entry Section is restarted to advance the splice to the Notcher, where an indent is created on the strip edges.

The splice is then advanced to the Edge Trimmer, which can now be adjusted to match the new strip width (if required). Upon completion of the Edge Trimmer adjustment, the Entry Section speeds up to the defined overspeed, thus refilling the Entry Accumulator. Once the normal operating level is achieved in the tower, the Entry Section is brought down to Process Section speed.

In the process section, the strip is fed through the Tension Levelling Equipment, and then through the Cleaning / Treatment Equipment, which consists of stainless steel vertical spray tanks.

The strip is now ready for coating: this is achieved by one S-wrap Lacquer Coater, which applies the coating to both sides of the passing strip. The coater is followed by a Curing Oven and an Air Cooler.

After cooling, the strip is fed through the Exit Accumulator to the Exit Section, which features a visual inspection station for both sides of the strip (horizontal and vertical), and a Waxer. The Exit Section also includes an Automatic Surface Inspection System for in line assessment of the quality of the coated strip, and an Edge Trimmer.

When the Exit Section stops for strip shearing, the Process Section keeps operating at normal speed, feeding the strip into the Exit Accumulator. The completed coil is unloaded by the Exit Coil Car and an empty spool is loaded onto the mandrel by the automatic Spool Loader. The Belt Wrapper is then engaged and the new coil can be started. Once the Exit Section is restarted and the strip achieves a steady tension condition, the Exit Section is accelerated to the defined overspeed, thus emptying the Exit Accumulator. When the accumulator reaches its normal filling level, the Exit Section is brought back to process speed.

**Detailed Description Of The Line Sections**

Entry Section

- A double payoff arrangement with over-unwinding capability provides a short time cycle and flexibility to the line operation.
- A simple, reliable, hydraulic shear crops the tail and front end of the strips.
- A double row type (arrow design) joiner achieves a secure joining of light gauge strip. The unit incorporates a hole punch for coil tracking.
- The vertical Entry Accumulator provides 110 seconds strip storage (net of ramp-down and ramp-up time) at maximum process speed. The upper carriage is movable, permitting easier strip threading operation. The chain type drive system, located on the upper platform, provides uniform movement of the motor driven carriage.
- The Entry Section also includes an Edge Trimmer.

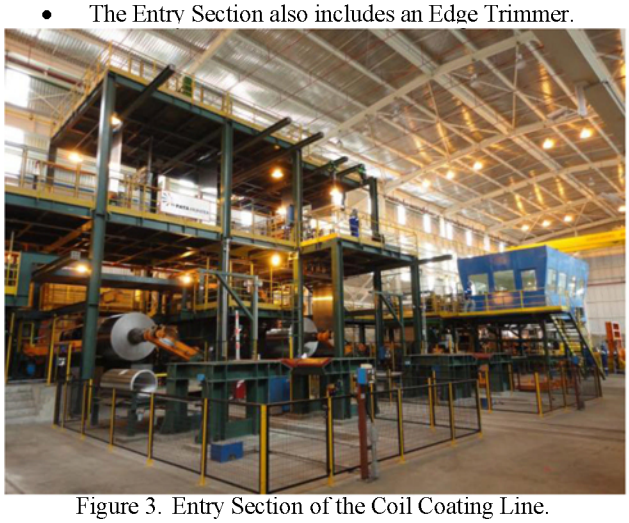

Figure 3. Entry Section of the Coil Coating Line.

Tension Leveling

- The Tension Leveling Equipment is installed in the Surface Treatment Section of the line (immediately after the Entry Accumulator) and consists of a 4-rolls entry bridle, an amplifier (leveler) and a 4-rolls exit bridle.

Figure 4. Tension Leveler of the Coil Coating Line.

- The combination of the bridle generated tension force and bending reversals in the leveling zone takes the strip beyond the material's yield point and thereby reduces the flatness errors in the strip to very low and acceptable levels.
- The amplifier is a pull-through, segmented backed-up, six-high, heavy duty design. The unit consists of a Leveler Zone and a Cross-Bow Zone.
- The unit consists of a solid frame with work cassettes which can be extracted from the side. This combines optimum rigidity, tight mechanical tolerances and ease of maintenance.

Surface Treatment Section – Cleaning

- The Cleaning Equipment provides excellent surface cleaning and is a key factor for good adhesion of the coatings being applied to the strip.
- The Cleaning Equipment consists of spray tanks arranged in a vertical configuration for optimum space utilization.
- The Cleaning Equipment consists of (4) alkaline cleaning stages followed by (2) rinse stages. The last rinse tank receives a fresh DI water supply, which is then cascaded back to the other rinse and cleaning tanks to ensure minimal water consumption.
- The use of stainless steel increases the life of the spray chambers and reservoirs. Quick disconnecting spray headers and a quick change squeegee roll design, significantly reduce maintenance costs and downtime.
- The line control system monitors the chemical treatment process parameters and acts as appropriate to keep them at the preset values to maintain optimum conditions of the treatment.
- Efficient counter-flow cascade of rinse water and cleaner solution reduce the consumption of water and chemicals and as a result, reduce heat (energy) consumption and waste treatment load.

Figure 5. Vertical Wet Section of the Coil Coating Line.

Surface Treatment Section – Pretreatment

- The Pretreatment Equipment applies the passivating agent to the strip, prior to lacquer coating.
- The Pretreatment Equipment includes (1) treatment stage followed by (1) DI water rinse stage and (1) final rinse (sealant) stage.
- The general design and control logic are similar to the one implemented for the Cleaning Equipment.

Lacquer Coater

- One Lacquer Coater is installed: it is S-wrap type with (1) 2-roll coating head for the top side and (1) 2-roll coating head for the bottom side. Both the top and the bottom side head are designed to accept the future installation of a metering roll.
- The roll pressure control is automatic, servomotor operated, with load cells feedback.
- The main coater motors are located outside the coater room, thus avoiding the need for explosion-proof equipment.
- On the other hand, all electrical equipment inside the room is explosion proof to maintain a safe environment for the coater operators.
- The coater is designed with thick side frames to limit vibrations.
- FATA Hunter's patented Single Slide design equipped with load cells and automatic nip pressure control achieves the most repeatable, uniform and accurate coating control. This improves the quality of the coated strip and reduces customer rejects and the application of excessive coating.
- The system's accuracy reduces paint costs and scrap, thereby increasing profits.
- Rolls are interchangeable to reduce spare parts. Split-hinged bearing blocks and quick disconnect couplings facilitate roll changes.
- Automatic opening/closing of coater heads for line stop/start/splice passage, and roll changing carts limit down times.
- Coaters are provided with forward/reverse coating capability.

Figure 6. Lacquer Coater of the Coil Coating Line.

Paint Curing System

- The system is designed to process the reference strip with the reference coating thickness at a maximum speed of 300 m/min and a PMT of 260 °C.
- Based on the curing requirements, a flotation oven, heated by zone burners, is installed. The oven is divided into (6) zones, each of them 8.4 m long, for a total dwell time of 10 s. Each zone has a variable speed circulation fan, which supplies air to the oven nozzles, providing the necessary heat transfer and flotation capacity for the materials processed in the line.
- Interlocking insulated panels are self-supporting when assembled with other panels forming a rigid structure. Access doors and explosion relief panels are included.
- A flow-out zone between the coater room and the entry to each oven allows the coating to flow evenly on the strip.
- (5) LEL sensors are installed: (1) in Zone 1, (2) in Zone 2, (1) in Zone 3, and one in the main exhaust duct.
- At the end of the oven, an infrared sensor measures the peak metal temperature of the strip.
- The curing oven is followed by a 3-zone air flotation cooler to reduce the strip temperature to 60 °C approx. The total length of the Air Cooler is 30 m.
- The exhaust air from the coating room is used as oven make-up air, thereby decreasing the air volume treated in the oxidizer, with the beneficial consequence of reducing the afterburner size and its operating costs.
- The Regenerative Thermal Oxidizer (RTO) collects exhaust gas from the oven and then destroys the VOC's (Volatile Organic Compounds). A waste heat hot water heater, heated by the exhaust gases from the afterburner, is used to heat the water for the surface treatment section.

Exit Section

- The vertical Exit Accumulator provides 105 seconds strip storage at maximum process speed. The upper carriage is movable, permitting easier strip threading operation. The chain type drive system, located on the upper platform, provides uniform movement of the motor driven carriage.
- An In line Surface Inspection System is installed in the Exit Section, allowing for automated detection of surface defects.
- A visual inspection station, equipped with fluorescent and stroboscopic lamps, allows for strip surface inspection, on both sides of the strip.
- The Exit Section is equipped with a vertical Wax Coater.
- An Edge Trimmer trims the edges of the coated strip in the Exit Section.
- A shear divides, crops the splice and takes samples from the strip.
- The Rewind Reel, with over- and under-winding capability, is equipped with automatic coil centering system and Belt Wrapper.

Figure 7. Exit section of the Coil Coating Line.

Electrical and Automation System

- Strip transportation is achieved using an AC vector drive system. Such state-of-the-art technology offers not only high performance of speed and tension regulation, but provides energy saving through the DC bus from which the inverters take their power.
- The operational HMI screens located in the entry and delivery control desks feature high resolution full color graphics, providing the operators with the ability to monitor all areas of the line.
- The system is a powerful, multi-tasking, PC and PLC based system. Screen pages allow production operators and supervisors to view/change operational parameters for the entire line including the vector drive system, chemical treatment system, chemical coater and dryer, prime and finish curing ovens, and the afterburner systems.

**Main Line Strengths And First Quality Tests**

The main line strengths can be hereafter summarized:

- Efficient line layout.
- Solid construction of the line – steelwork very sturdy and framework laid out in robust fashion.

Figure 8. A detail of the framework on the Coil Coating Line.

- Line access and egress via catwalks and platforms is superior.

Figure 9. View of the catwalks/ platform of the Coil Coating Line.

- Accumulators, though very tall, are solid and operate smoothly to full height. They also have very good steering units within the towers, and useful braking equipment in case of strip breakage.

Figure 10. View of the entry section and of the crane structure for replacing rolls in tower.

- Entry/Exit Pulpit is large and strategically located and has good visibility to Entry and Exit of line. It is used effectively as a team meeting space for line control and decision making.
- Wet Section design appears to be very effective. Squeegee and turn roll change out is relatively uncomplicated and does not require cutting of the strip.

Figure 11. View of the Wet Section of the Coil Coating Line.

- Wet Section Blowoffs are powerful and give the option of Hot or Cold blowoff.
- Coater Room is spacious, allowing for safe working.
- Coater Head is impressive. It features single slide operation, and runs smoothly through its paces. Bottom head shuttles out for easier cleaning.

Figure 12. View of the Coater Head on the Coil Coating Line.

- Curing Oven/Regenerative Thermal Oxidizer (RTO) system is well made and very capable of fast heat up and cool down. There is a flotation oven, and a 5 chamber RTO.
- Air Cooler is lengthy and does a very good job of reducing temperature after Curing. It has the same strong construction as the Curing Oven.

The line includes a state-of-the-art accident prevention system, with interlocked gates preventing operator access to hazardous areas. When the operator needs to enter an hazardous area, all equipment is de-energized before the gate can be unlocked, thereby allowing a safe access to the line.

Figure 13. Example of the accident prevention systems at Coater.

After the 1st painted coil on 1st May 2014, some significant quality tests have been performed on aluminium coated samples.

All coated aluminium material before being sent to the customers undergoes a strict quality control to ensure the final properties of the product.

## Conclusions

This paper describes the main features and the first operational results of the new FATA Hunter High Speed Single Coat (double faces) Coil Coating Line for Aluminium Coated End Stock.
The line has been supplied to Novelis, world leader in aluminium rolled products, at their facilities in Pindamonhangaba (São Paulo Province). This is a state-of-the-art line, running up to 300 m/min, that includes FATA Hunter patented single slide coaters for the best paint thickness accuracy.
The main strengths of the line are an efficient layout and a very effective design of each single section. The first quality tests performed on aluminium coated samples confirm a very good uniformity of application of lacquer and a homogenous application of wax over the length and across the width of the processed coils.

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