
NUCOR®
A325
A325
NUCOR STEEL SOUTH CAROLINA

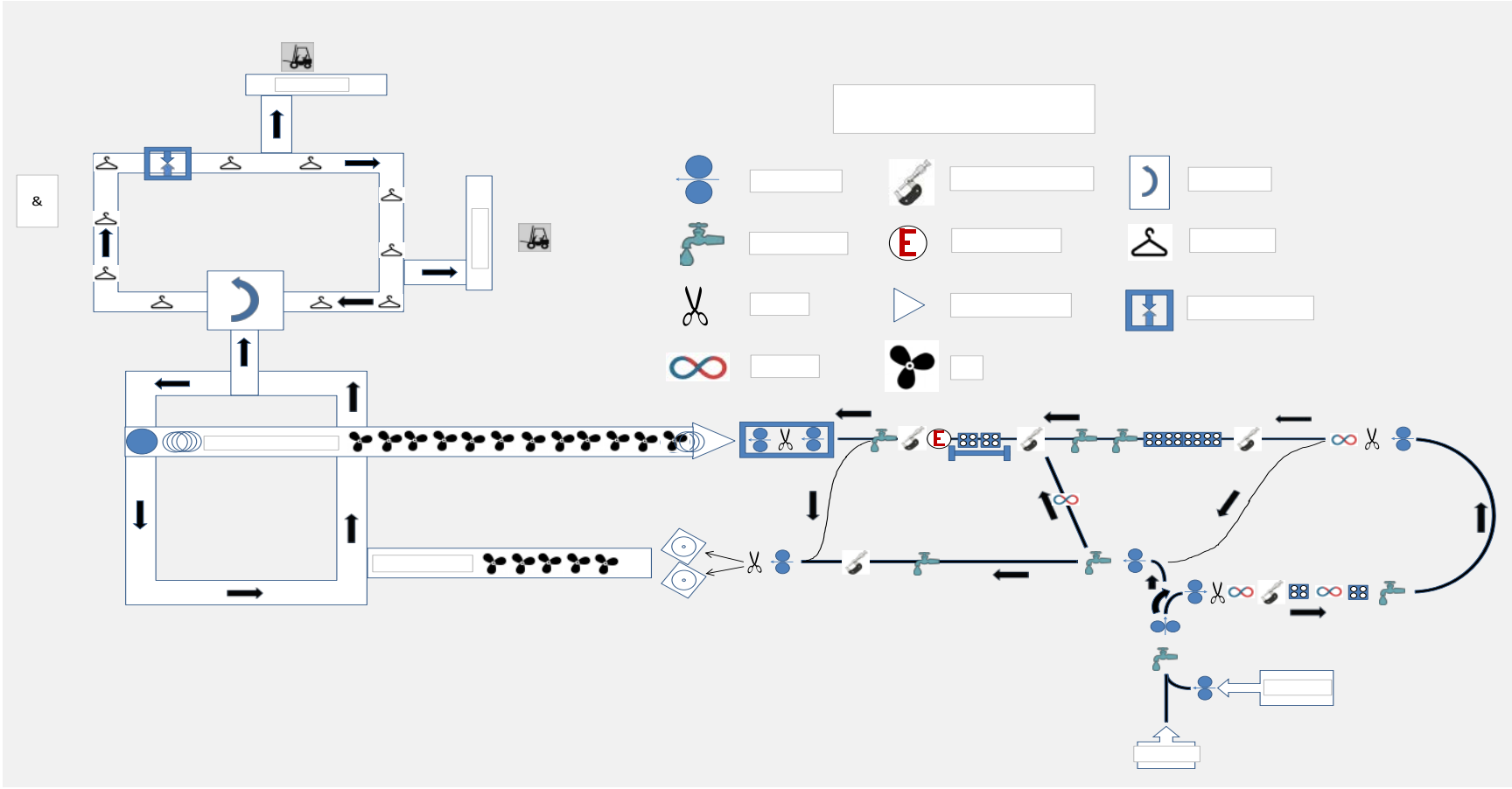
Nucor Steel South Carolina

First Nucor steel mill (1969)

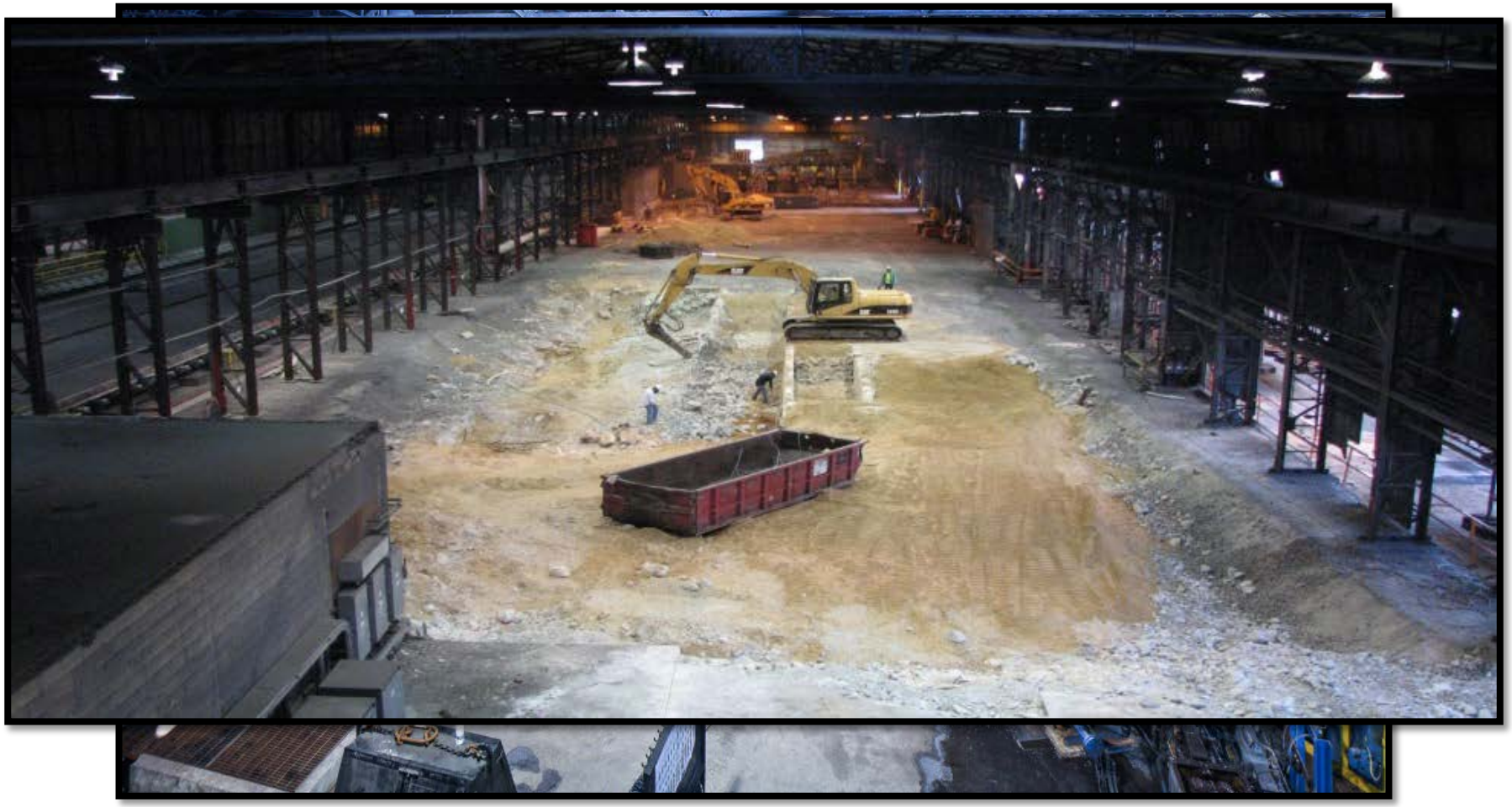
- First EAF mill in U.S.
- became prototype for mini-mill industry

Over $450 million in equipment and facility upgrades in last ten years

Rod Mill Expansion



- Demolition Began September 2012
- Wire Rod Line commissioned September 2013

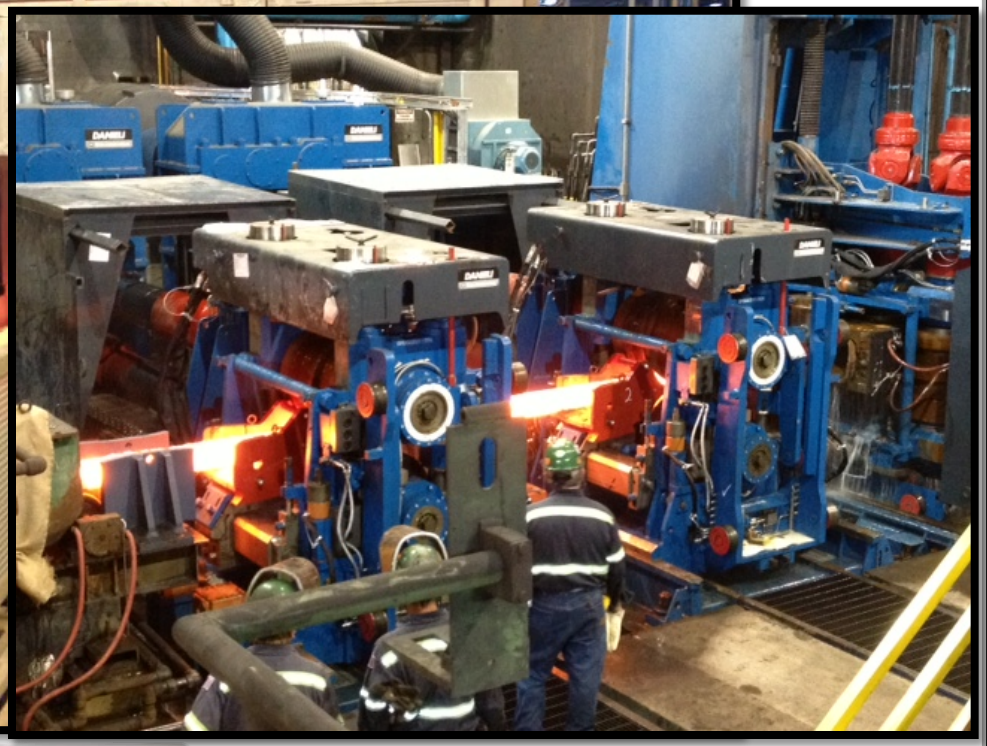


September 2, 2013 - First Wire Rod 7/16" BM2

APRIL 2, 2013

L

MAY 28, 2013
FIRST BAR ROUGHERS
MILL 2

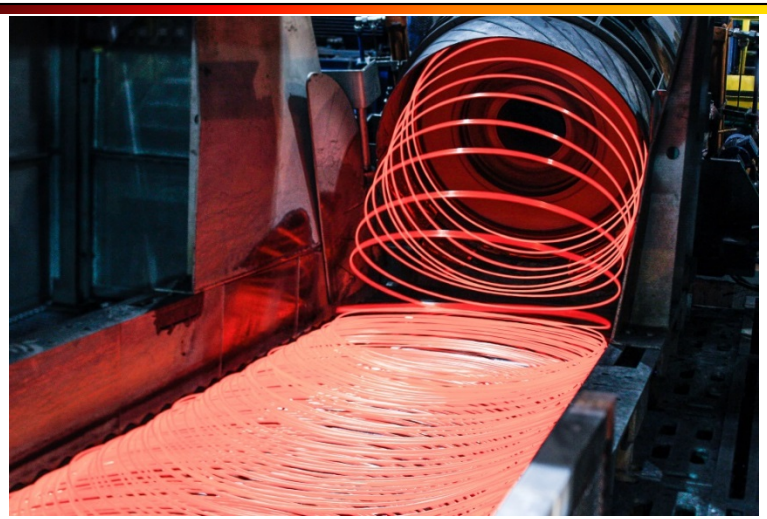


Wire Rod Line

- Two of the two-stand pre-finishing blocks
- The eight stand fast finishing block
- The two-stand Twin Module Blocks
  (two interchangeable quick change carts)
- Five water boxes
- Two shears
- The High speed shear

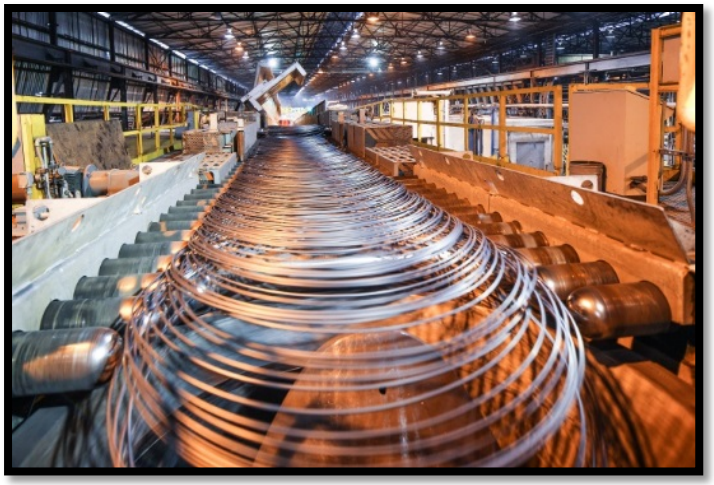
Laying Head

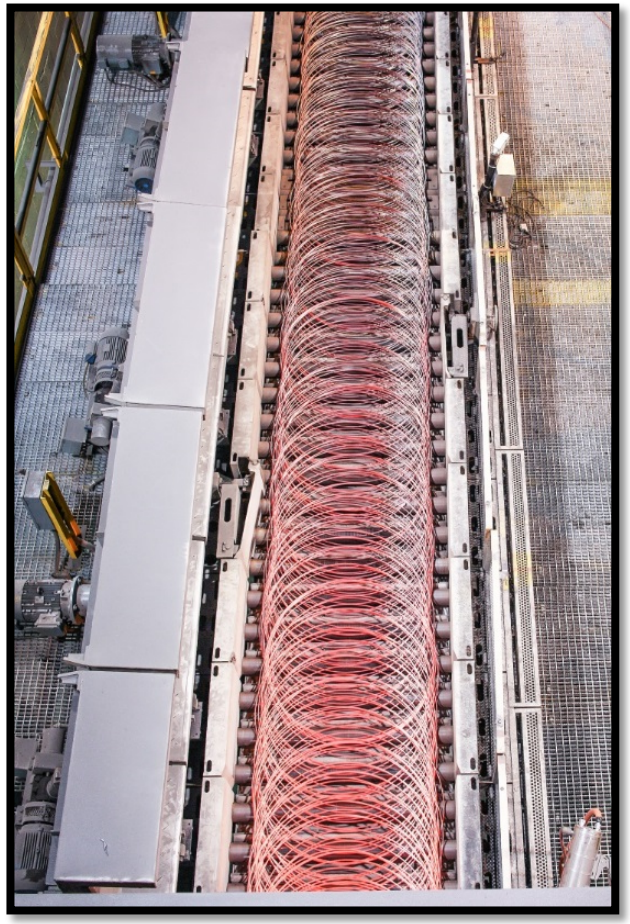
- Dual pipe
- Wobble
- Auto nose position
- Tail end speed control



Cooling Conveyor and Reform Tub

- The 315’ long cooling conveyor with hoods
- Eighteen individual variable speed fans





New Process Control Related Upgrades and Capabilities

- New Danieli High Test System
  - Hot eddy current tester after TMB
- New Section and Profile gauges
  - Section Gauges before each rolling section
  - Profile Gauge after TMB
- New production sampling and testing areas
  - Magnafux
  - Upset testers
  - Measuring equipment
  - TL-2 CNC Lathe, HAAS
- New production Lab
  - Tensile tester
  - Saw and grinder
  - Upset tester and furnace
  - DV-6 OES Spectrometer, Baird

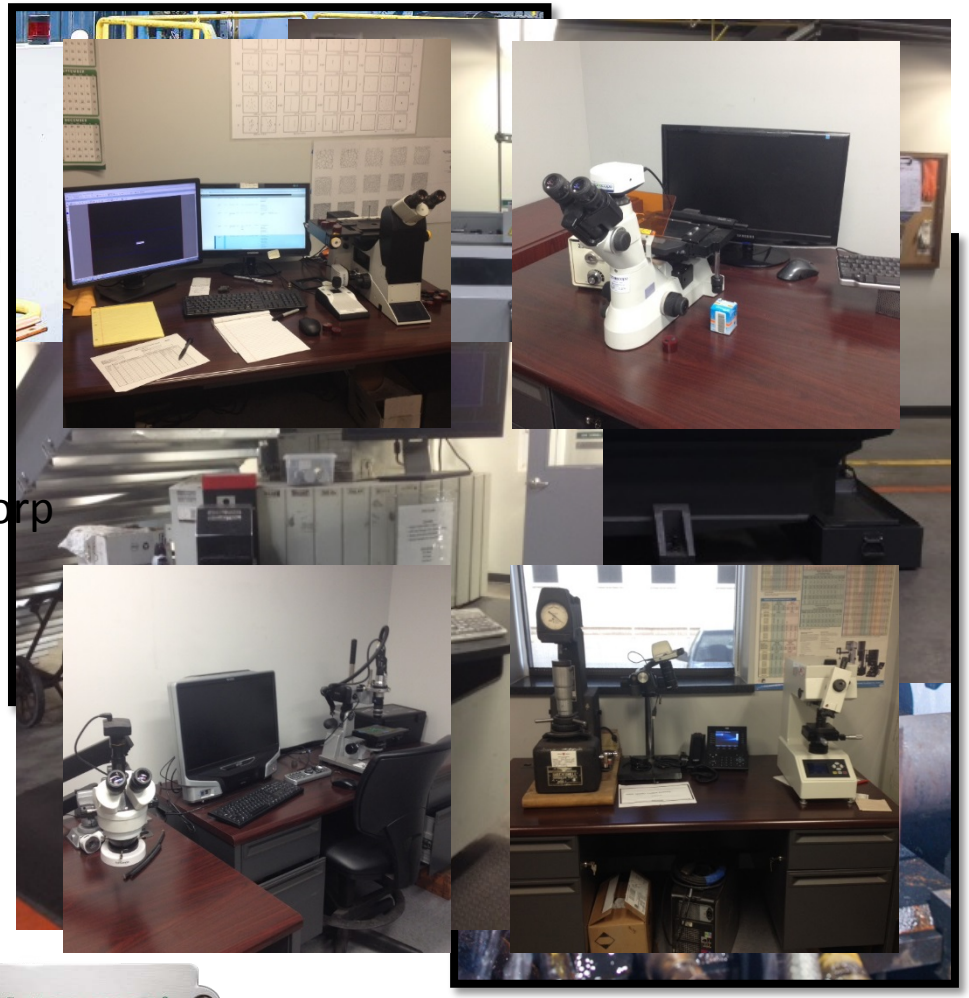
Clemex Vision PE, Automatic inclusion ratings and grain vsize

Two TS100

Nikon new

VHX-5000 Digital microscope, Keyence Corp

Wilson Digital micro hardness tester



Finished Product Dimensions

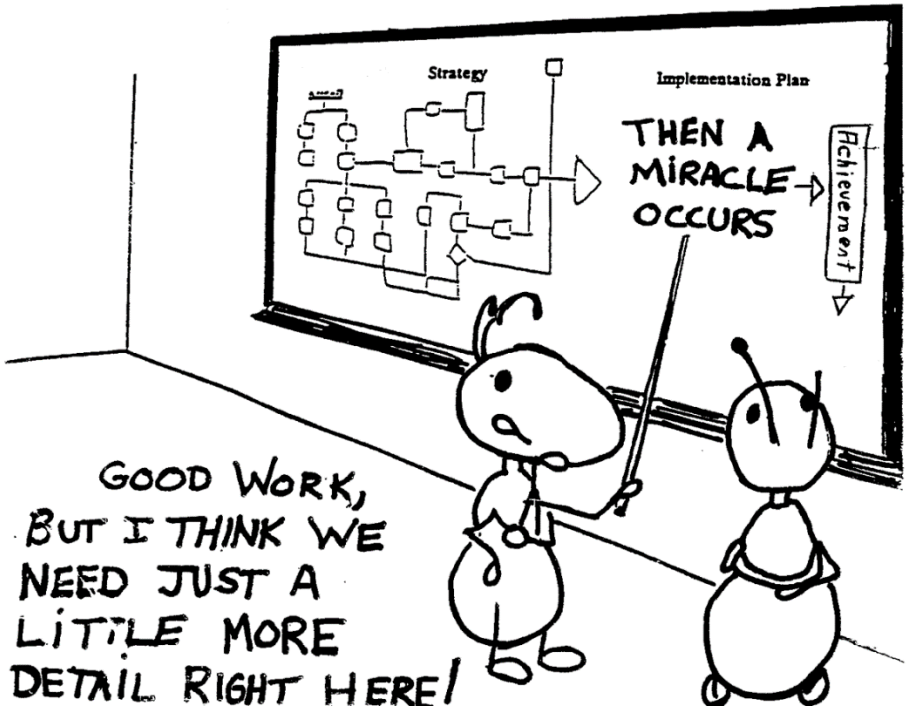
Product	Min Size	Max Size
Rod	7/32"	57/64"
Bar in Coil Rounds	15/16”	1-13/16“

Product	Max Weight	OD (inches)	ID (inches)
Rod	5,600	52	36
Bar in Coil Rounds	5,600	55	42

Training and Team Building

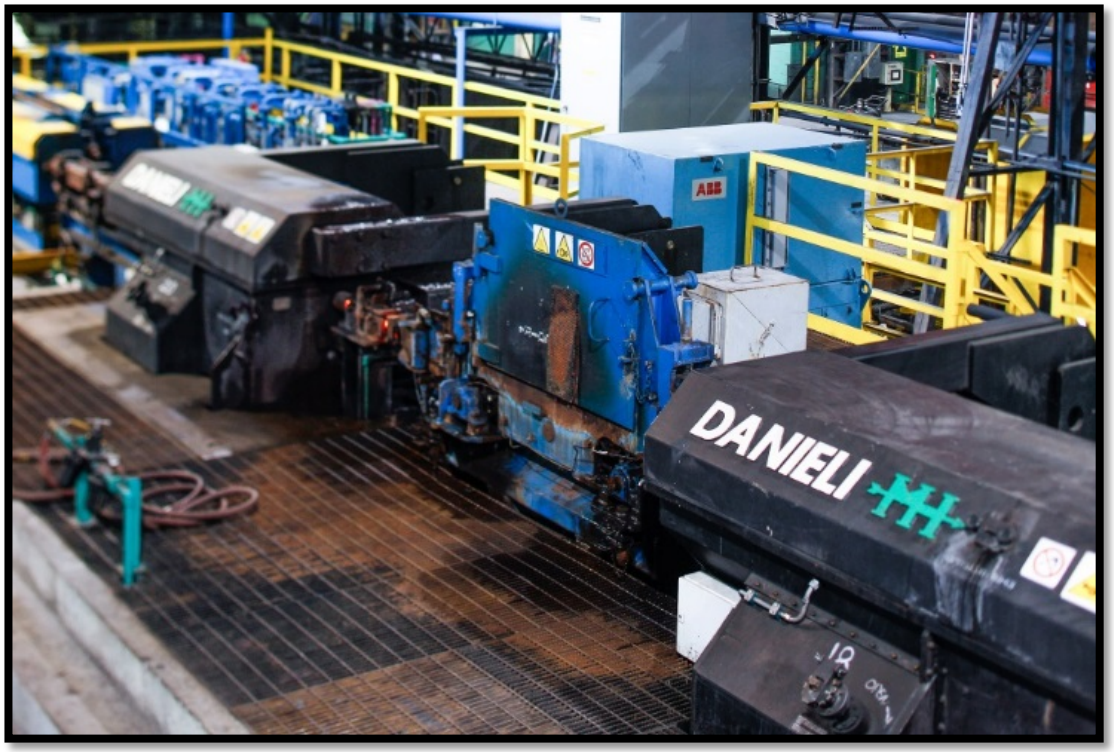
- Extremely diverse product range:
  - Angle
  - Channel
  - Flats
  - Large Rounds
  - Squares
  - Coiled Rounds
  - Rod

Lessons Learned



Tension Control

- Added two additional loopers
  - One between Mill Finish Stand and Prefinishers
  - One between Prefinishers and TMB (1/2” Rod and above)



Water in Instrument Air

- Caused problems with:

  Pinch Rolls, Loopers, and air actuated valves

- Added two additional dryer systems

Water Cleanliness

- Caused clogging in equipment and cooling lines
- Added strainer baskets to filter water

What to do about rolls?

- **What products will be rolled?**
  - 52 different product sizes out of the TMB alone.
    - With sales input, 35 sizes were selected for initial offering.
- **What grades of steel will be rolled?**
  - 1006 ~1080+
  - Alloy grades
- **How many rolls are required?**

Planning & Training

- **Key Nucor Darlington personnel visited SinterMet and other Nucor facilities.**

- **On site training of all affected Nucor - Darlington personnel.**

  * General knowledge and use of carbide rolls.

  * Proper handling / storage

  * Roll redress / evaluation of wear

Initial Complement of Rolls

- Rolls were supplied as Fully Finished to support the 35 Target Sizes that were to be supplied by the mill.

- Blank rolls were inventoried at SinterMet and Nucor both for future conversion as sizes were added.

  8 different classifications of rolls were inventoried in various quantities.

- Pass grooves were added to the blank rolls so as to support additional product sizes and meet the rolling schedule demands (3 week window).

Material Grade Selection

Material grades for various rolls

- **Pinch Rolls**
  - Mill layout and design
- **Pre-Finisher Rolls**
  - 4 stand pre-finisher (17 ~ 20)
- **Rod Block Rolls**
  - 8 stand block (21 ~ 28)
- **TMB Rolls** (Twin Module Block)
  - TMB # 1 = 2 stands (29 ~ 30)
  - TMB # 2 = 2 stands (31 ~ 32)
- **Hex Rolls**
- **Guide Rollers**

Material Grade Selection

- Selection Criteria
  - Thermal Crack Resistance (Thermal Fatigue)
  - Corrosion Resistance (Corrosion)
  - Wear Resistance (Friction & Abrasion)
  - Impact Resistance (Irregularities)
  - Yield Strength (Rolling Stresses)

Evaluation of Mill Water

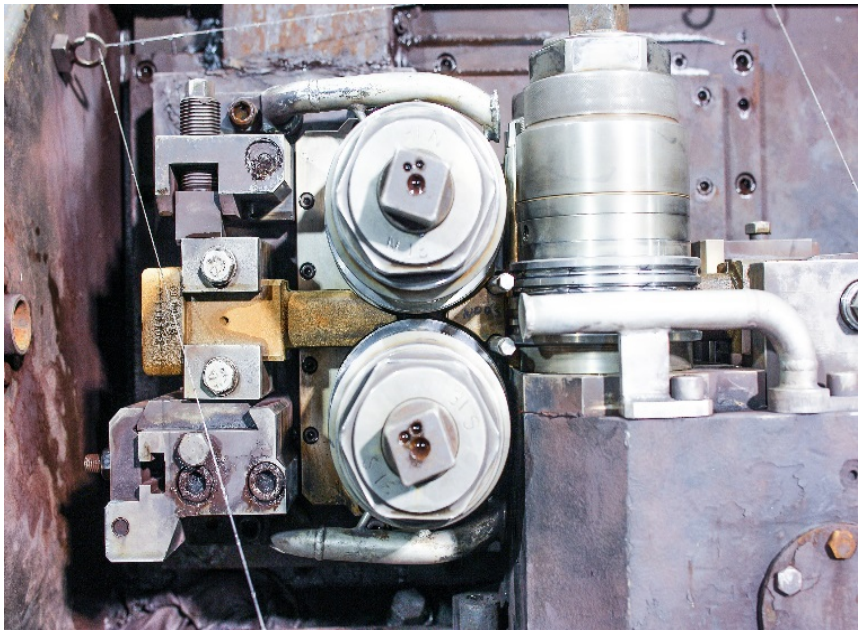
- **Cooling water supply and chemistry.**
  - Initial evaluation of water.
  - Changes made to supply of water to new mill isolating it from melt shop.
  - Monitoring of water quality / chemistry.

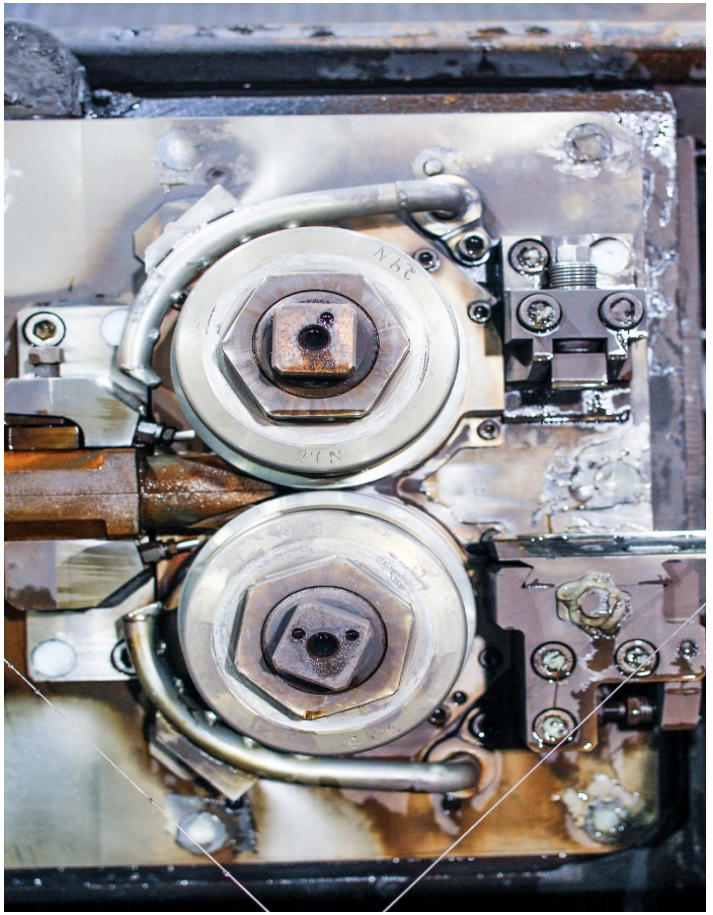
Recommended Water Chemistry

Chloride (mg/L)	40 Max
Sulfate (mg/L)	75 Max
Nitrite/Nitrate (mg/L)	2 Max
$CaCO_3$ (hardness mg/L)	200 Max
Suspended Solids (mg/L)	80 Max
Total Alkalinity (mg/L)	100 Max
Iron (mg/L)	25 Max
pH	7.5 to 8.5

Water Headers

- Clear of Debris
- Check for Wear / Damage
- Proper Location





The New Roll Shop

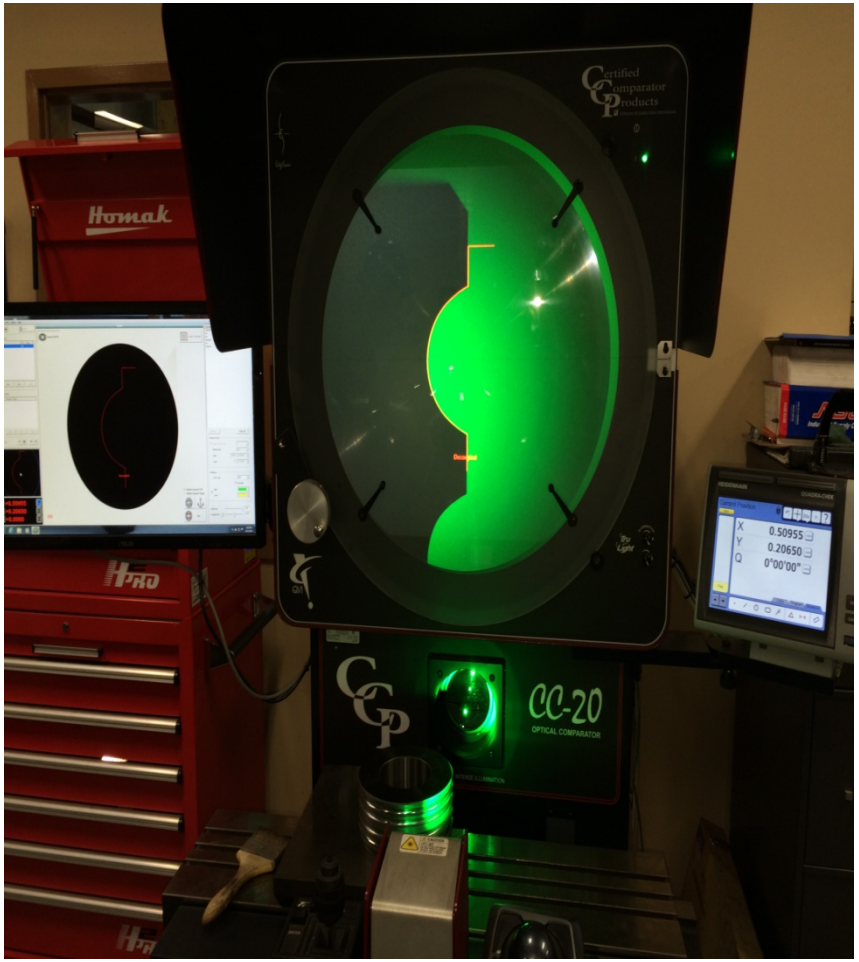
Roll Storage

Roll Handling

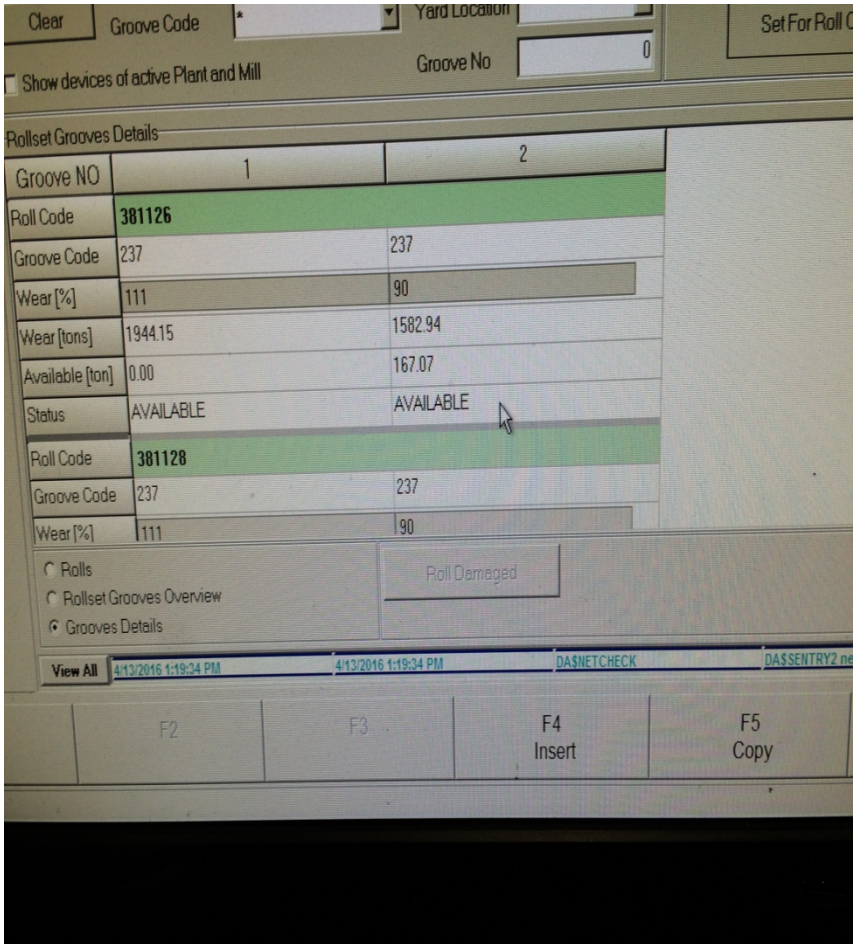
Transport from Roll Shop to Mill Deck

Roll Grinding / Redress

Roll Grinding / Redress

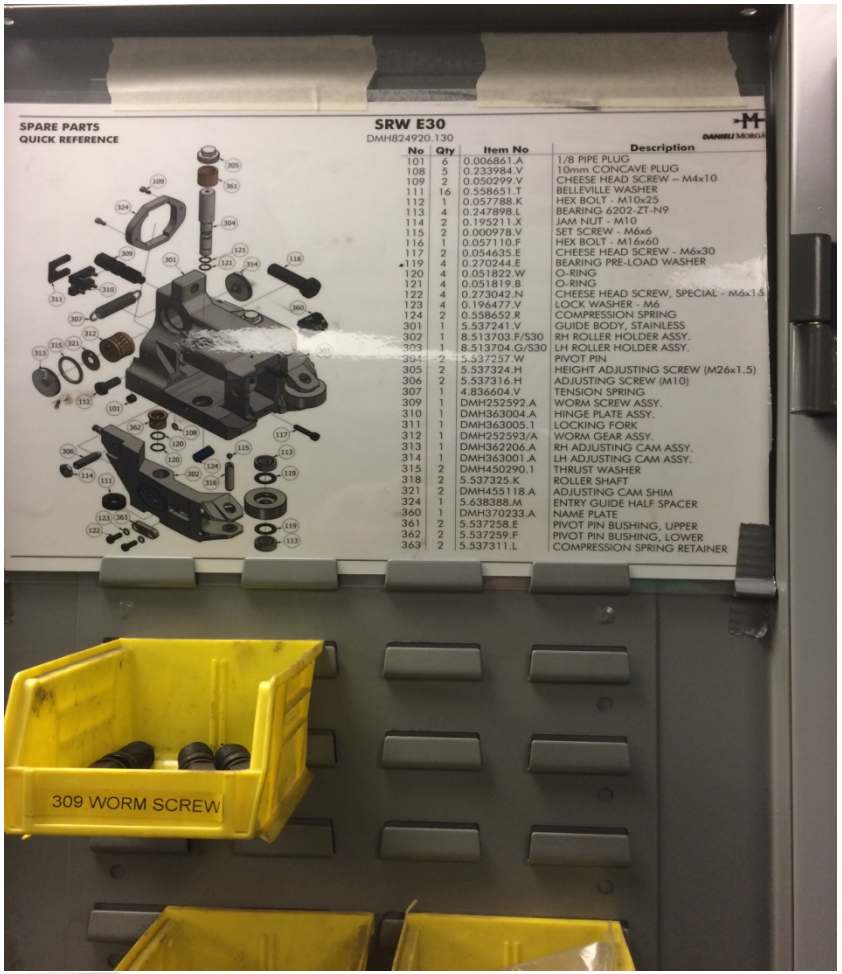


Roll Inventory / Tracking / Performance



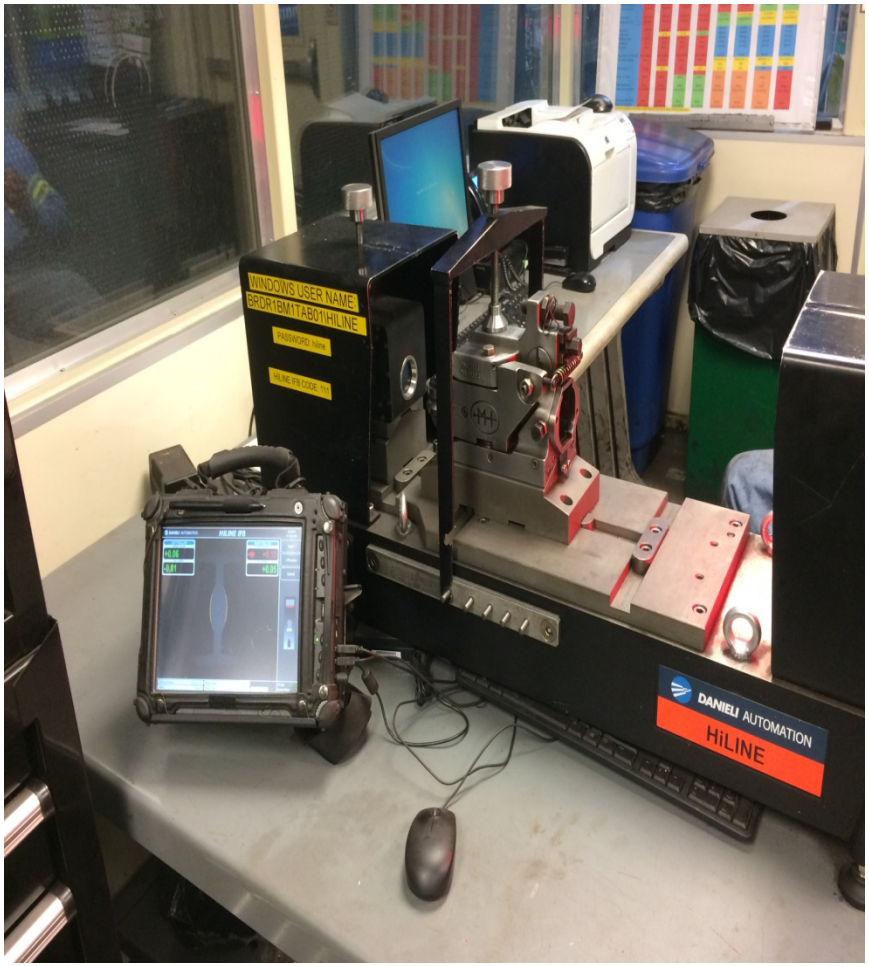
Tungsten Carbide Grinding Swarf

Guide Roller Program



No	Qty	Item No	Description
101	6	0.006861.A	1/8 PIPE PLUG
108	5	0.233984.V	10mm CONCAVE PLUG
109	2	0.050299.V	CHEESE HEAD SCREW – M4x10
111	16	0.558651.T	BELLEVILLE WASHER
112	1	0.057788.K	HEX BOLT - M10x25
113	4	0.247898.L	BEARING 6202-ZT-N9
114	2	0.195211.X	JAM NUT - M10
115	2	0.000978.V	SET SCREW - M6x6
116	1	0.057110.F	HEX BOLT - M16x60
117	2	0.054635.E	CHEESE HEAD SCREW - M6x30
119	4	0.270244.E	BEARING PRE-LOAD WASHER
120	4	0.051822.W	O-RING
121	4	0.051819.B	O-RING
122	4	0.273042.N	CHEESE HEAD SCREW, SPECIAL - M6x1.5
123	4	0.196477.V	LOCK WASHER - M6
124	2	0.558652.R	COMPRESSION SPRING
301	1	5.537241.V	GUIDE BODY, STAINLESS
302	1	8.513703.F/S30	RH ROLLER HOLDER ASSY.
303	1	8.513704.G/S30	LH ROLLER HOLDER ASSY.
304	2	5.537257.W	PIVOT PIN
305	2	5.537324.H	HEIGHT ADJUSTING SCREW (M26x1.5)
306	2	5.537316.H	ADJUSTING SCREW (M10)
307	1	4.836604.V	TENSION SPRING
309	1	DMH252592.A	WORM SCREW ASSY.
310	1	DMH363004.A	HINGE PLATE ASSY.
311	1	DMH363005.1	LOCKING FORK
312	1	DMH252593/A	WORM GEAR ASSY.
313	1	DMH362206.A	RH ADJUSTING CAM ASSY.
314	1	DMH363001.A	LH ADJUSTING CAM ASSY.
315	2	DMH450290.1	THRUST WASHER
318	2	5.537325.K	ROLLER SHAFT
321	2	DMH455118.A	ADJUSTING CAM SHIM
324	1	5.638388.M	ENTRY GUIDE HALF SPACER
360	1	DMH370233.A	NAME PLATE
361	2	5.537258.E	PIVOT PIN BUSHING, UPPER
362	2	5.537259.F	PIVOT PIN BUSHING, LOWER
363	2	5.537311.L	COMPRESSION SPRING RETAINER

Guide Roller Program



Quality Product & Successful Management of Rolls / Rollers

- Set limits for roll usage
  - Pinch Rolls
  - Rod Block Rolls
  - TMB Rolls

- Assigned responsibility for roll / roller management
  - Mill Lead-man
  - Daylight Guide Technician
  - Roll Shop Grinder Operator

FINISHED PRODUCT QUALITY

Did the Plan Work?

Check / Act

- Roll Breakages?
- Changes to established roll tonnages?
  - By roll type / roll family / demand of product size
- Review stock removal amounts on rolls?
  - Performance Indicators
- Additional product sizes will be added to offering?
  - Affect roll families / rolling schedule
- Water chemistry changes?
- Equipment Wear / Maintenance
  - Areas of focus

Teamwork

Nucor Steel – Darlington

SinterMet, LLC.