
CHARTER STEEL
PROCESS CONTROL STRATEGIES
FOR HIGH QUALITY STEEL
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1


CHARTER STEEL
Charter Steel places a strong emphasis on quality control in the steelmaking processes.
• Inclusions
• Segregation
• Seams
• Decarb/Recarb
• Scabs/Slivers
• Microstucture

2

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MELTING

3

3

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Non-Metallic Inclusions in Steel

- Non-metallic inclusions are impurities in steel.
- NMI can cause surface and internal defects.
- They can reduce the strength and toughness of steel.
- NMI are typically made up of Al, Ca, and Mg from various external sources within melting/casting

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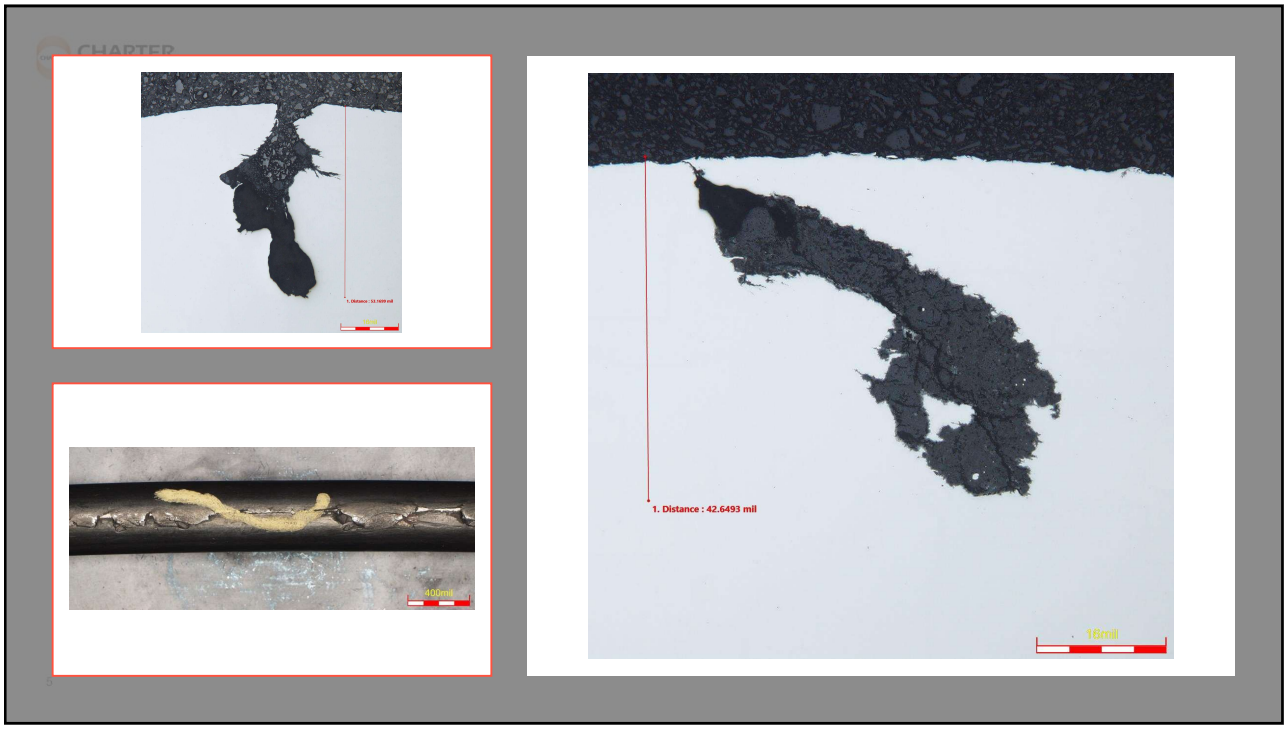

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Process Controls for NMIs

- Oxygen injection and foamy slag practice at primary melt (EAF)
- EBT Furnace Design – (Eccentric Bottom Tap)
- Argon Stirring in Ladle during refine process
- Tundish design
- Tundish opening steel level control to prevent vortexting
- End of cast tundish level monitoring

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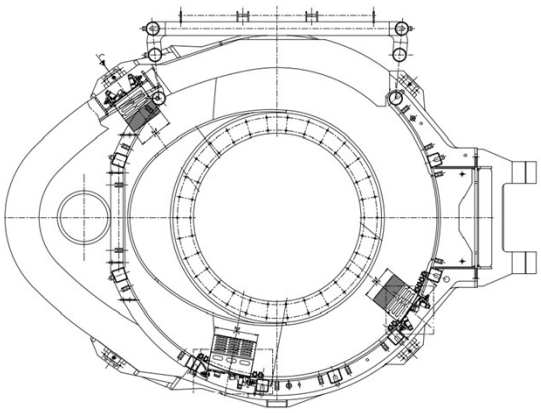
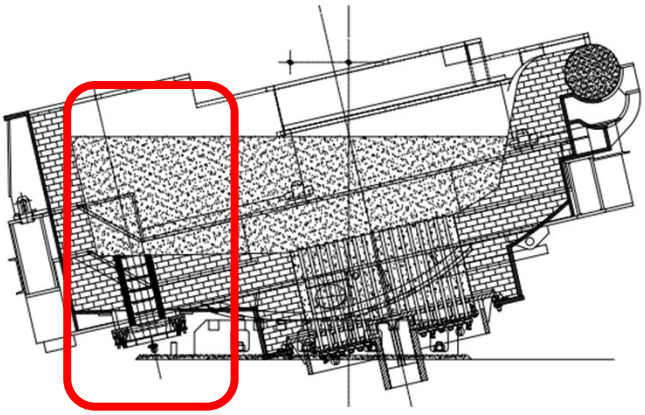
EBT Furnace design – Steel depth over Tap Hole





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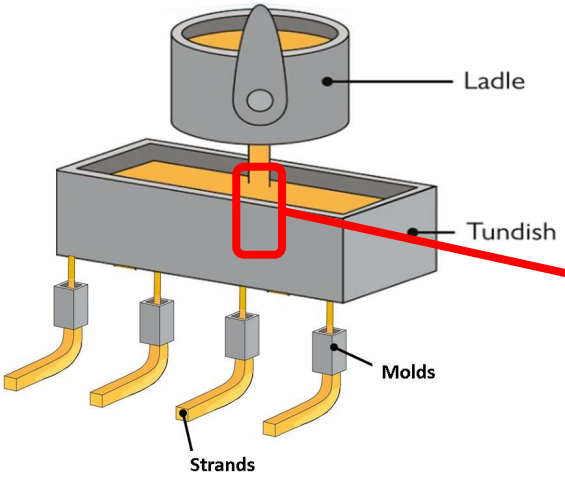
Tundish Impact pad & dam



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Caster tower profile showing ladle and tundish

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9

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Segregation in Steel

- Chemical segregation in steel is an uneven distribution of elements, such as carbon, sulfur, manganese, and chromium, throughout the cross-sectional area of a billet as it solidifies
- The segregation is a normal process that happens during this solidification stage, but Excessive segregation can result in cup-cone breaks, reducing the strength of the steel.

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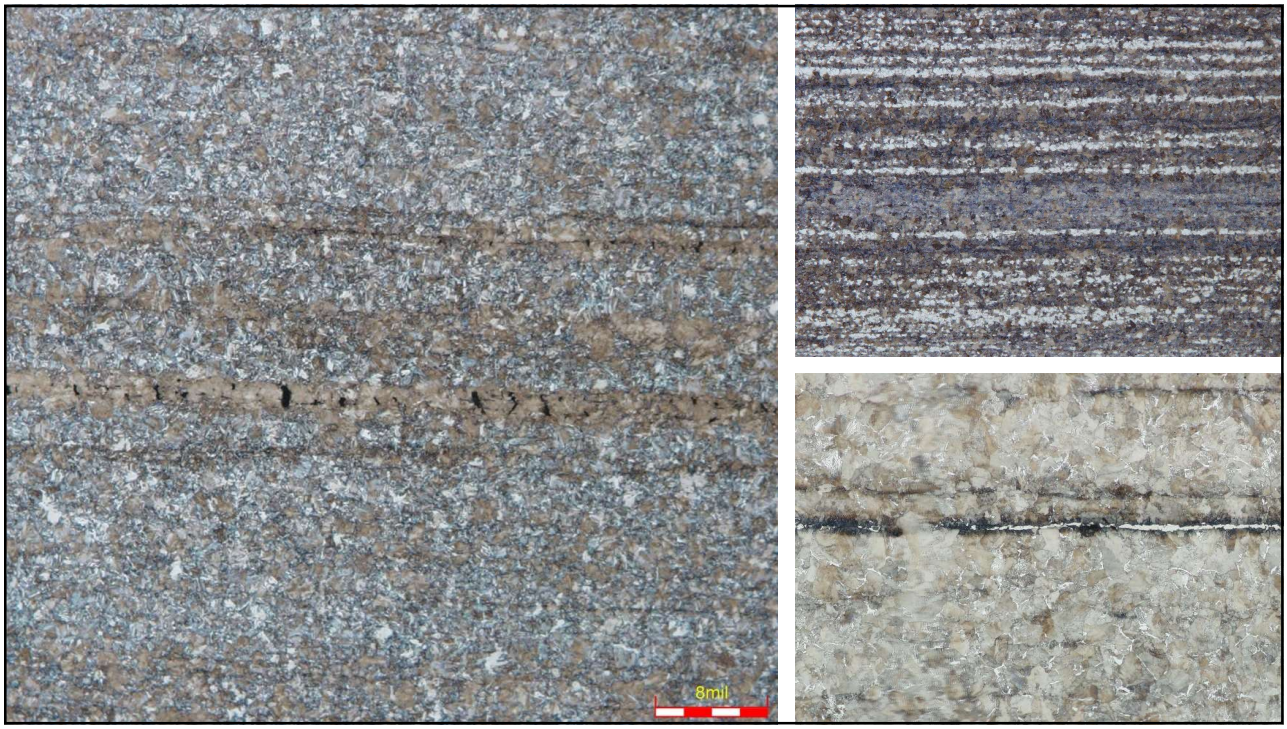

11

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Process Controls for Segregation

- Temperature
- EMS stir in the mold
- Mold Level
- Speed

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12

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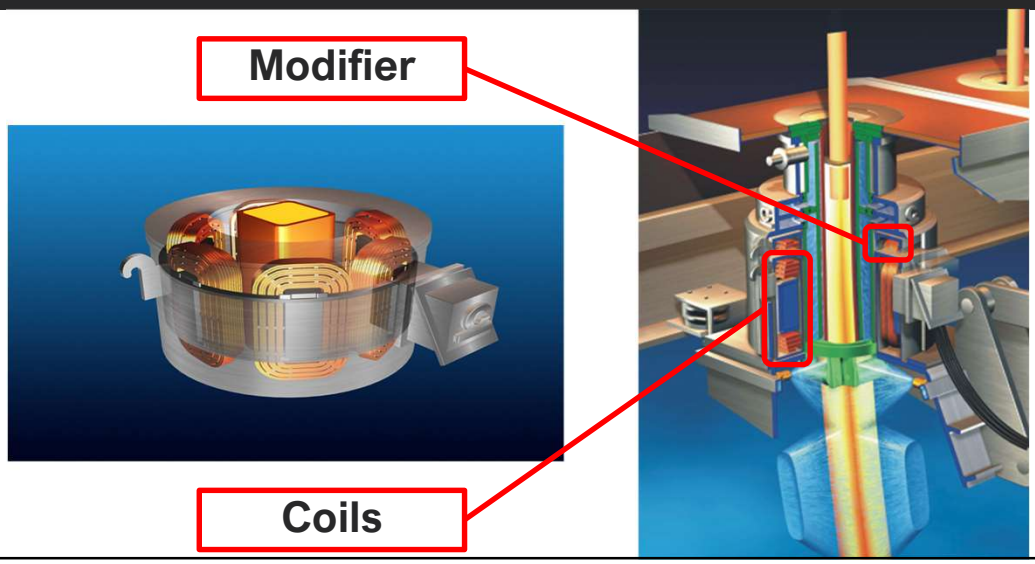
Dual Coil Electro Magnetic Stir



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Seams in Steel

- Seams are a straight, elongated crevice running parallel to the length of the steel product.
- Seams may appear tight or closed at the surface, but they are not fully welded shut. This deceptive appearance can make them challenging to detect visually.
- They can cause head or flange splits/bursts during upsetting of fasteners.
- Seams typically do not exceed about 0.030" in depth and are usually < 0.015".

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14

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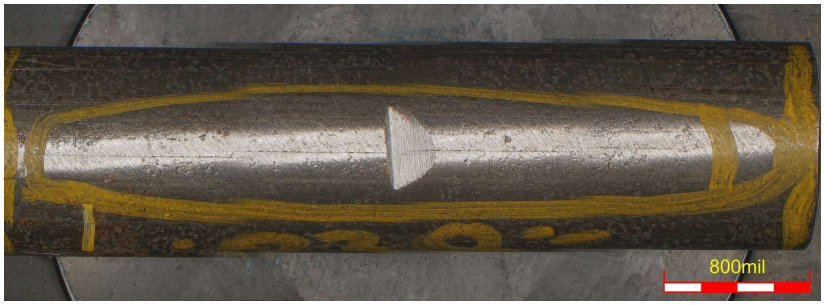

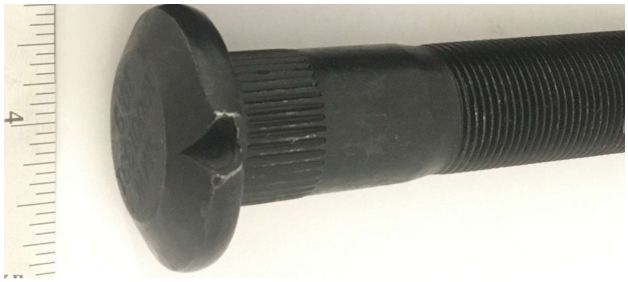

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16

16

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Process Controls for Seams

- Degas during refine process to minimize soluble gas
- Tundish Practices - Moisture
- Shield molten steel from atmosphere
- Maintain constant heat removal
- Mold Lube Flow
- Even Cooling in the Mold to prevent thermal cracks
- EMS stir in the mold

17

17

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Tundish spray liner and drying practices

18

18

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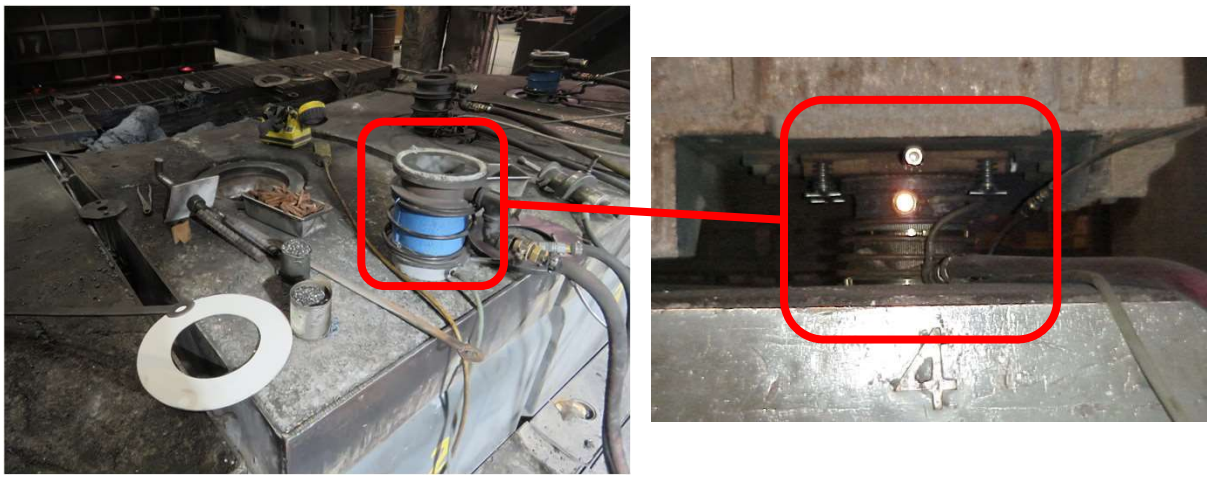
Continuous Casting

Mold Shrouding – Bellows shroud & SENS



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Continuous Casting

Mold Shrouding – Bellows shroud & SENS

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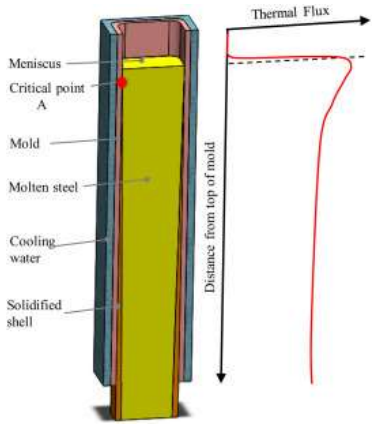
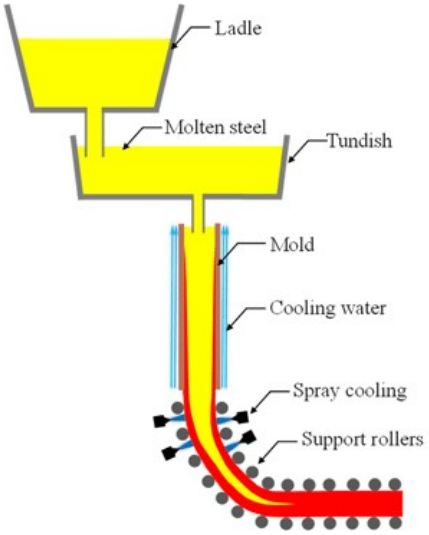
Even Mold Cooling





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21

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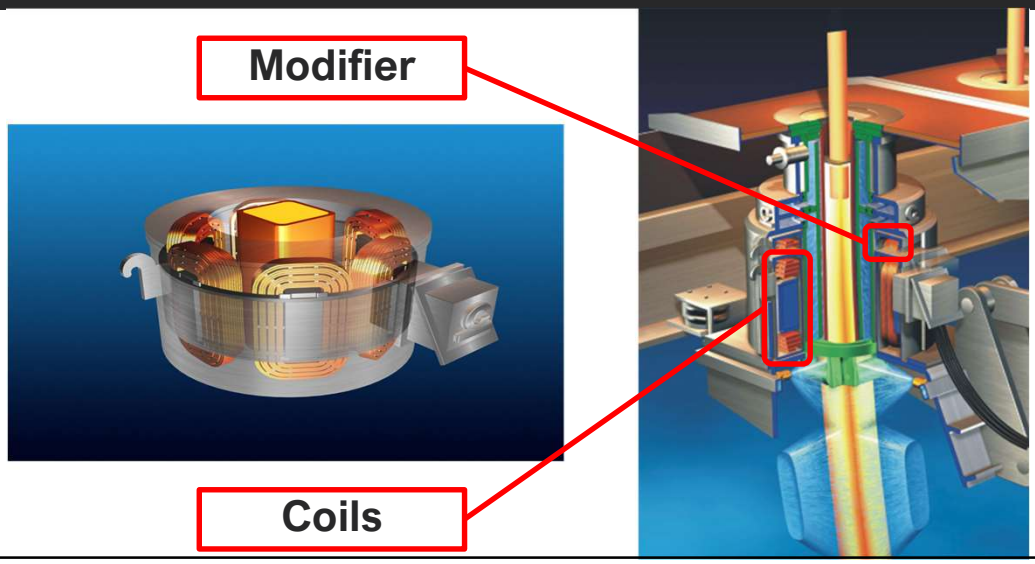
Dual Coil Electro Magnetic Stir



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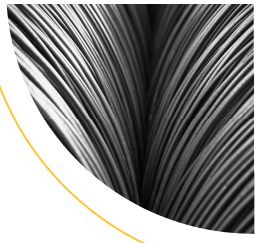
ROLLING & PROCESSING



23

23

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Decarburization in Steel

- Decarb is the process of losing carbon content in steel.
- It occurs due to incorrect atmosphere control during annealing or reheat furnace.
- Decarb can weaken the steel and negatively impact its properties.
- Decarb can be evaluated through microscopic and microhardness analysis.

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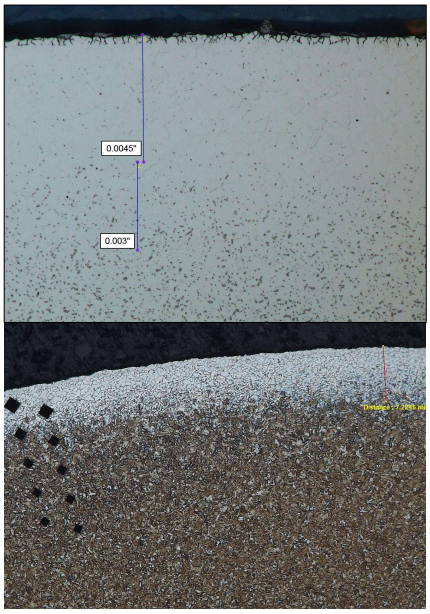

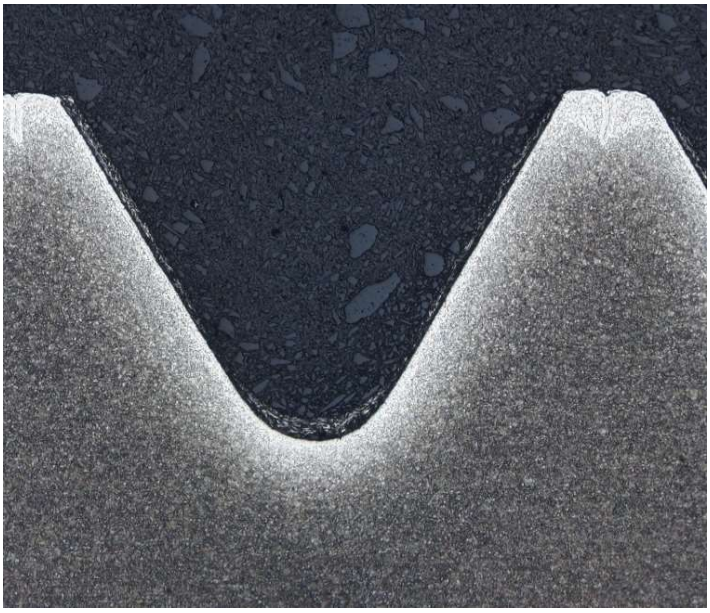

25

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Process Controls for Decarb

- Level II automation (Rolling Mill)
- Level II alarms (Rolling Mill)
- Trend screens (Processing)
- Furnace atmosphere (Processing)

26

26

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Recarburization in Steel

- Recarb is the process of gaining carbon content in steel on the surface.
- It occurs due to incorrect atmosphere control during annealing.
- Recarb can harden the steel surface and negatively impact its properties.
- Recarb can be evaluated through carbon analysis, QC evaluation.

27

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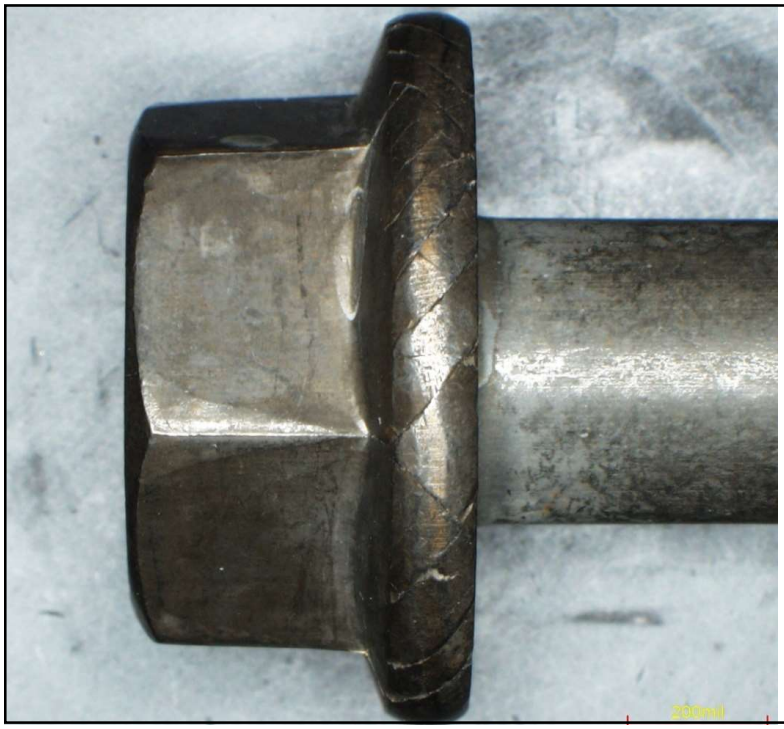

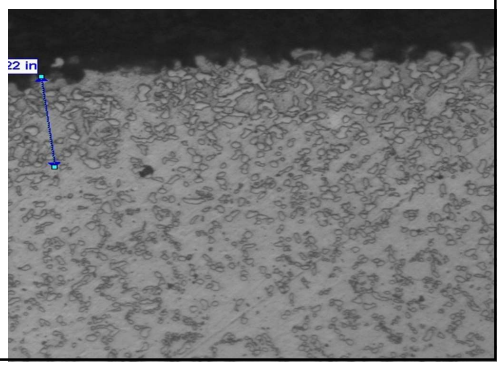

28

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Process Controls for Recarb

- Trend screens
- Furnace atmosphere
- QC Inspection

29

29

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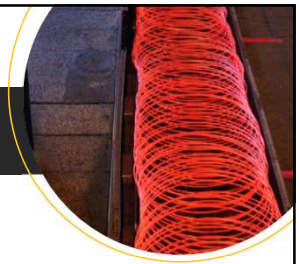
Scabs and Slivers in Steel



- Scabs and slivers are often the result of billet defects or damage during hot rolling.
- These defects are typically almost parallel with the surface
- Decarb/dispersed oxides are sometimes associated with the defects
- Scabs and slivers can cause problems like head or flange splits/bursts during upsetting of fasteners.

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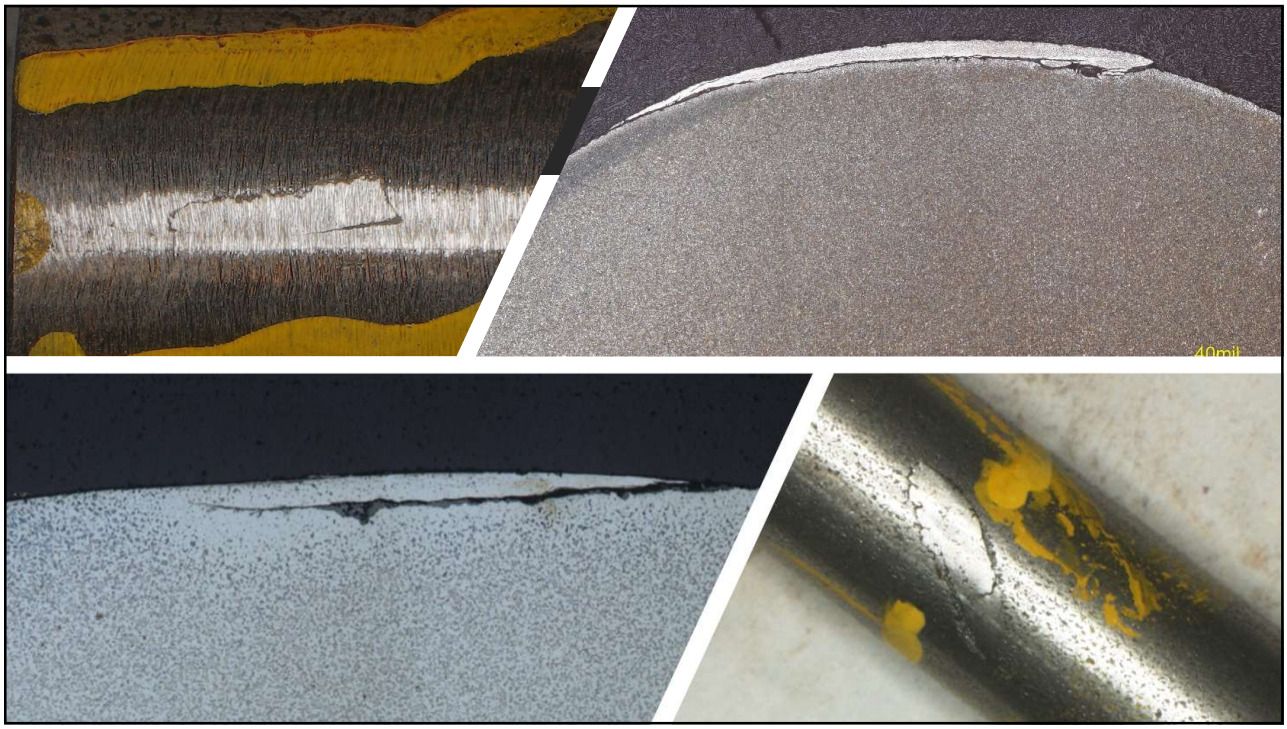

31

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Process Controls for Scabs/Slivers

- Billet Item Setup
  - Sequence limitations
  - Billet Inspections and Audits
- Eddy Count analysis
  - Feedback from rolling to melting
  - Live rolling mill feedback
- Roll Profiles, Roll Gaps, Tons on Rolls
- “Sticking the mill”

32

32

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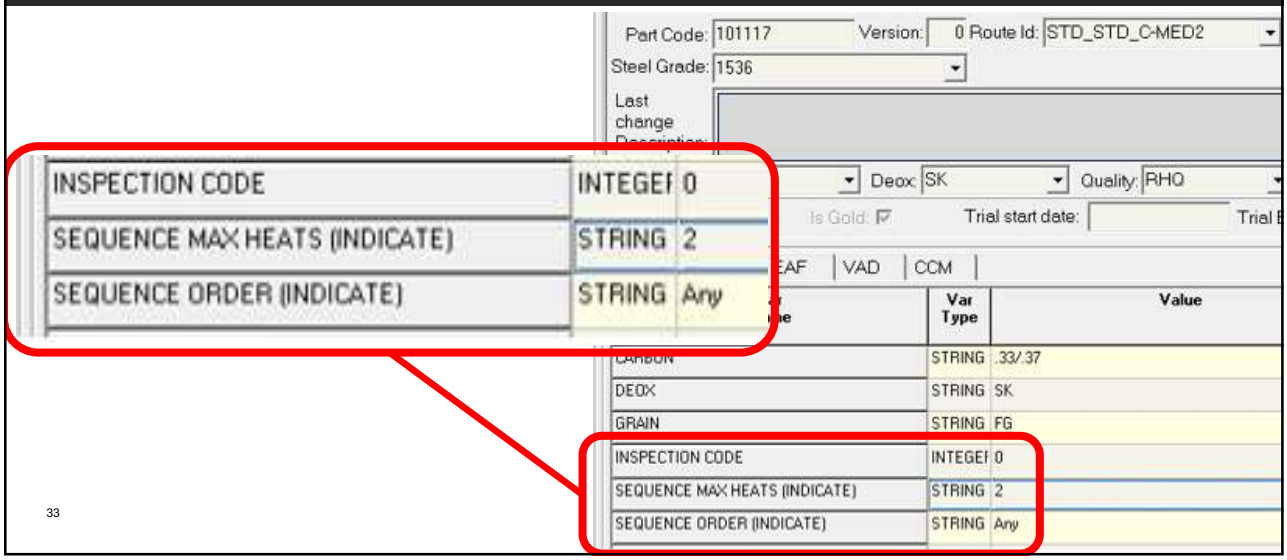
Melting Item Setup



33

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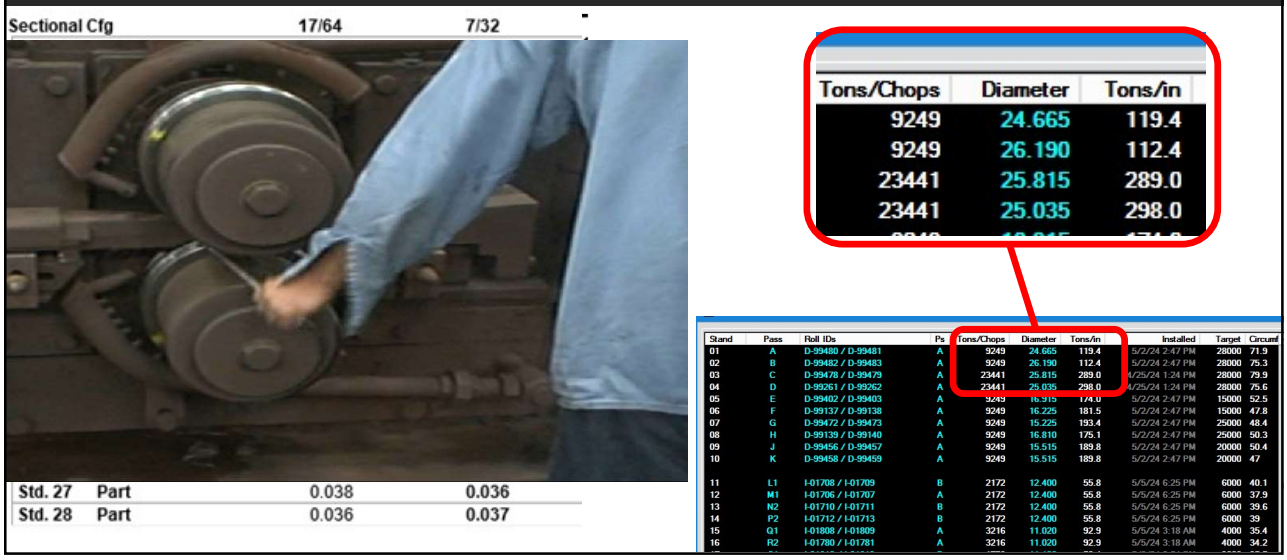
Roll Profiles, Roll Gaps, Tons on Rolls



34

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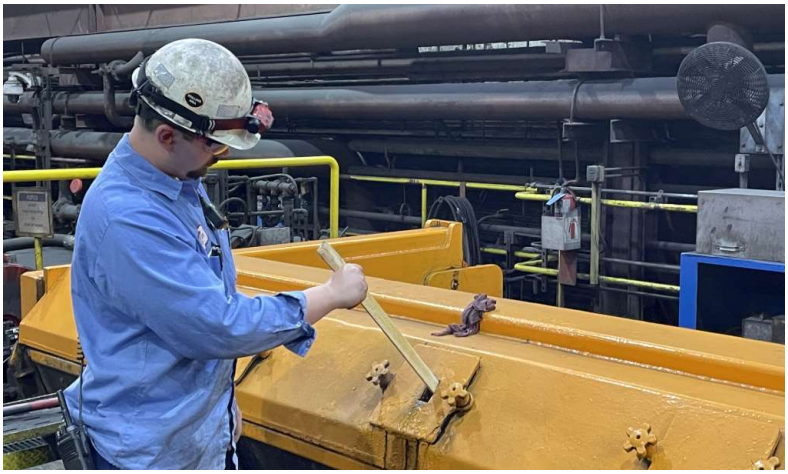
STICKING THE MILL



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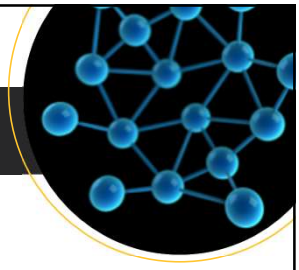
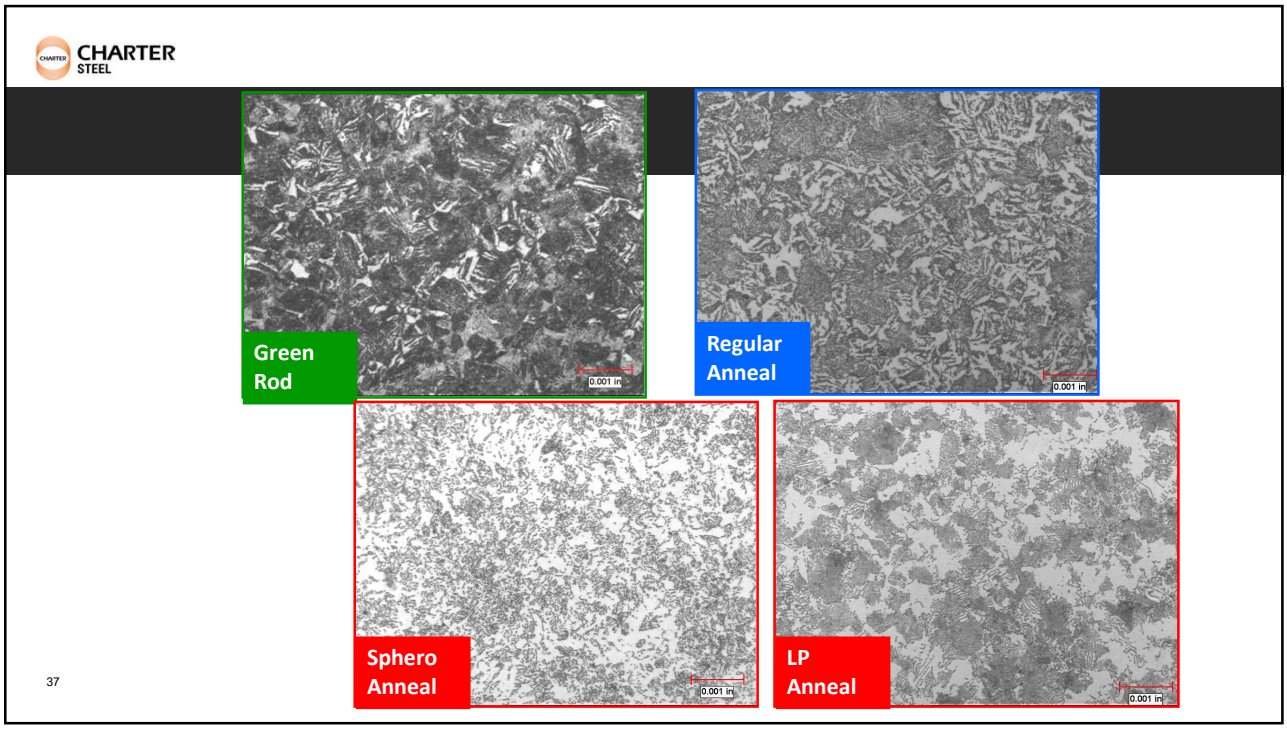
Steel Microstructure



- The arrangement of atoms and crystals in steel
- It can greatly impact its strength, toughness, and ductility
- Properties can be changed by manipulating the steel's microstructure through annealing
- Understanding and controlling steel microstructure is critical in producing high-quality steel products

36

36


CHARTER STEEL
Green Rod
Regular Anneal
Sphero Anneal
LP Anneal
0.001 in
37

37


Questions?
Defects and Process Control
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38