



**Mack Part #509GC471  
Batch "U" Liner Manufacturing  
Federal Mogul Visit  
4/10/2013**

# Batch “U” Liner Manufacturing

- Visited Federal Mogul Liner production plant in Lake City, MN on 4/10/2013
  - Reviewed Specifications
  - Observed operations
    - Casting (other liners)
    - Cutting
    - Grinding
    - Finish Honing
  - Set up Initial expedite orders

# Batch “U” Liner Manufacturing

- Liner Specifications
  - Crosshatch Angle =  $45^{\circ} \pm 2.5^{\circ}$
  - Rvk =  $40 \mu\text{in} \pm 5 \mu\text{in}$
  - Target Values of other parameters
    - Ra =  $14.9 \mu\text{in}$
    - Rk =  $37.9 \mu\text{in}$
    - Rpk =  $10.6 \mu\text{in}$
    - Rmr1 =  $6.1 \%$
    - Rmr2 =  $82.5 \%$
    - Vo =  $3302250 (\mu\text{in} * \mu\text{in})/\text{in}$

# Batch “U” Liner Manufacturing Process Review

## – Cast Liners

- Class 40 Cast Gray Iron
- Material verified at the beginning of each casting run
  - One liner is sectioned for microstructure analysis and sent to the spectrometer for composite analysis
- About 0.090” oversize to allow for machining

## – Liners are parted from the mold

- Done by a tumbler system to separate parts and sand

## – Sent to plant in Minneapolis to be through hardened

- Hardening verified with 1 piece per treated lot

# Batch “U” Liner Manufacturing Process Review (continued)

## – Machining Line

- Rough bore cut and dimensions verified
  - About 0.008” under to allow for finish honing
- Upper Flange/Pilot surface cut and deburred
- Outer diameter ground and dimensions verified
- Inner bore honed
  - 6 - 4” length stones x 0.300” width – 320 grit vitreous stone, H bond
  - Stones changed every 20 liners – First liner on new stones discarded
- Crosshatch angle, dimensions and surface finish verified
  - Every piece measured in 9 places at floor level for surface finish
  - Every piece is measured for dimensions at floor level
  - 1 piece per shift is measured by the metrology lab for all print parameters (surface finish, angle’s, runouts, concentricity’s, etc.)
- Liners cleaned, oiled and packaged

# Batch "U" Liner Manufacturing

## Casting Cope

6 liners cast at one time



# Batch "U" Liner Manufacturing Casting Flask Ready for Pour



# Batch "U" Liner Manufacturing Castings in the Cooling Line





# Batch "U" Liner Manufacturing Casting After Separation



# Batch "U" Liner Manufacturing Castings Ready for Machining



# Batch "U" Liner Manufacturing Liner Work Line



# Batch "U" Liner Manufacturing Initial Boring Station



# Batch "U" Liner Manufacturing Flange Cutting and Deburring Station



# Batch "U" Liner Manufacturing Liner Outer Surface Grinding



# Batch "U" Liner Manufacturing Liner Outside Measurement Device with Standard



# Batch "U" Liner Manufacturing Honing Device





# Batch "U" Liner Manufacturing Honing Fixture Clamp



# Batch "U" Liner Manufacturing

## Liner being Honed



# Batch "U" Liner Manufacturing Liner Dimensional Measurement



# Batch "U" Liner Manufacturing Liner Surface Finish Analysis



# Batch "U" Liner Manufacturing Liner Cleaning and Rust Prevention Coating



# Batch "U" Liner Manufacturing Surface Finish Device in Metrology Lab



# Batch "U" Liner Manufacturing Pleasures of Winter Travel



# Batch “U” Liner Manufacturing

- Questions?