

## **Ellwood Clean Steel** **Large Diesel Engine and Compressor Crankshafts**

The Ellwood Clean Steel process begins with steelmaking and includes forging, heat treating, and finish machining operations. Steel for large diesel engine and compressor crankshafts is produced by electric arc furnace melting, ladle refining, vacuum degassing processes prior to bottom pouring into an ingot mold. The ingot is then open-die forged into a slab or rolling pin configuration. Upon completing forging and heat treatment operations the forging is rough machined to a near net shape configuration to allow for precision finish machining.

The attached paper presented at International Forgemasters Conference 2008, entitled “The Manufacture and Properties of Large Crankshafts produced with Open Die Forging Practices” provides details related to the Ellwood Clean Steel process while thoroughly documented achieved results. The enhanced properties achieved with low sulfur content and calcium treatment are clear.

### **Steelmaking**

- Electric Arc Furnace
- Ladle Refinement
- Vacuum Degassing
- Extremely tight chemistry control
- Low sulfur content (0.005% Max) and calcium treatment to minimize the volume fraction and control the shape of sulfide inclusions

### **Forging / Heat Treatment**

- Slab or rolling pin configuration
- Twisting journals optional
- Normalize, quench, temper
- Longitudinal and transverse properties that meet and exceed customer and marine society specification

### **Finish Machining**

- Extreme precision and accuracy
- CNC five-axis mill turn technology
- Maximum work piece length 12m weighing up to 24 metric tons
- Crankshaft journal cylindricity to exceed .005mm

The Ellwood Clean Steel process is currently being used to manufacture large diesel engine crankshafts for engine builders such as CAT/Mak and Wartsila marine engines and Weir Minerals slurry pumps. This process is also accepted through Self Certification and Works Approval with many of the International Association of Classification Societies (IACS) including Lloyd’s Registrar (LR), Germanischer Lloyd (GL), Det Norske Veritas (DNV), American Bureau of Shipping (ABS), and Bureau Veritas (BV).