

APEX™ G2 HH NEXT GENERATION RAIL

Developed through designed experiments including the production of more than 25 heats of steel over the past 2 years

Provides a superior performing rail grade that features best-in-class Life Cycle Cost (LCC) performance

Metallurgical design of Apex G2 HH provides superior:

- Wear and Rolling Contact Fatigue (RCF) performance
- Fracture toughness
- Ductility
- Weldability

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Next Generation Rail

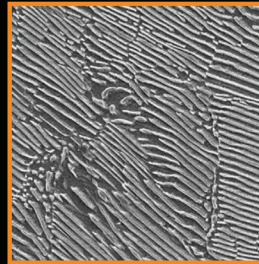


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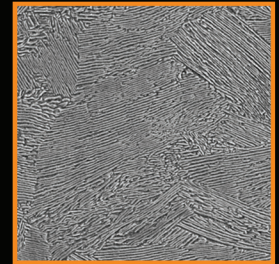
Apex G2 HH is designed with Refined Pearlite Interlamellar Spacing

- EVRAZ Bulk Alloying Strategy → Refined Pearlite interlamellar spacing with unmodified welding cycle
- EVRAZ Microalloying Strategy → Improved Ductility and Fracture Toughness
- Refined Interlamellar Spacing → High Strength and Hardness → Improved Wear and Rolling Contact Fatigue (RCF) Performance

Extremely fine pearlitic microstructure resulting from Apex G2 alloying and heat treatment



SS rail



Apex G2 HH rail

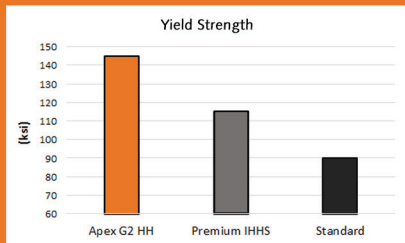
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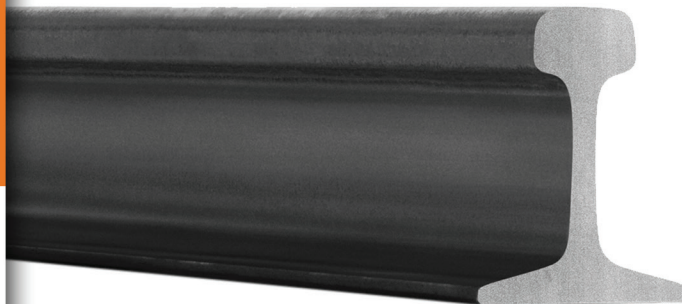
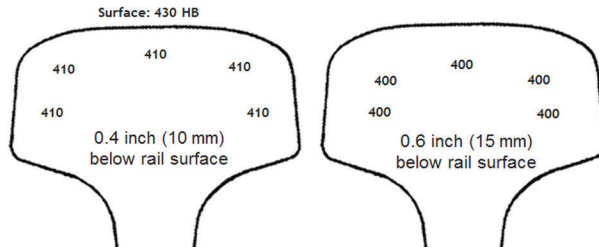
STRENGTH & HARDNESS

Superior yield strength (10 to 15 ksi increase [70 to 100 MPa] in comparison to the highest strength rail available) to resist plastic deformation during wheel / rail contact

High hardness / hardness at depth



Apex G2 HH Internal Hardness



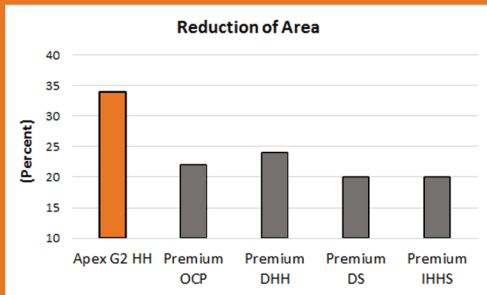
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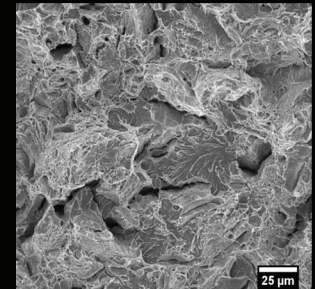
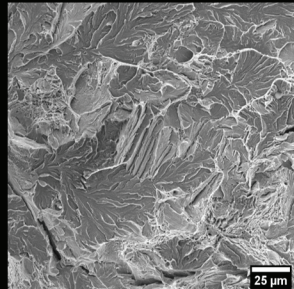
MECHANICAL PROPERTIES

DUCTILITY

- Improved tensile elongation response
- Far superior reduction of area (greater than 20% improvement in comparison to conventional rail)



Example Tensile Fracture Surfaces



Conventional Hypereutectoid Rail vs Apex G2 HH Next Generation Rail

Tensile sample shiny fracture surface is traditional cleavage fracture of high strength pearlite

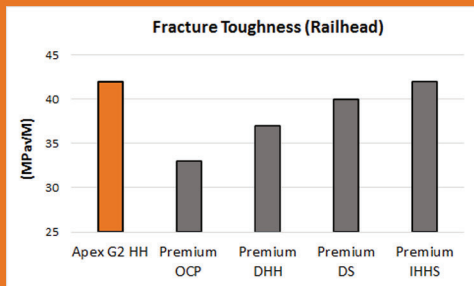
Dull region of tensile fracture surface is consistent with ductile microvoid coalescence

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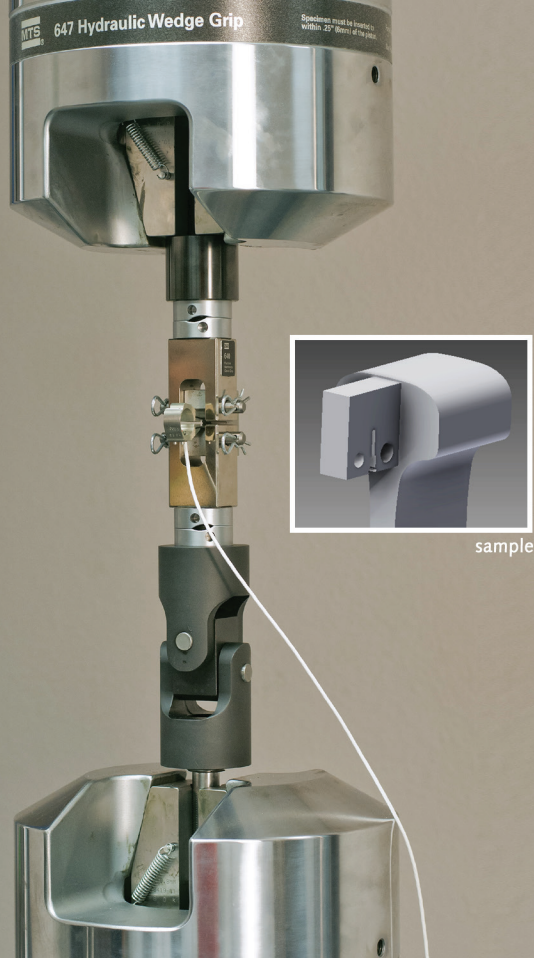
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FRACTURE TOUGHNESS

- Apex G2 HH offers a 15% improvement in K_{IC} fracture toughness
- Engineered for enhanced safety and performance in track



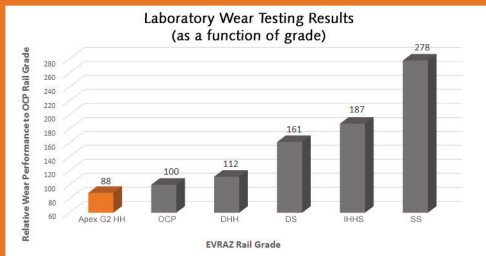
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WEAR BEHAVIOR

- Apex G2 HH demonstrates a 12% improvement in laboratory wear resistance
- Engineered for increased rail life and decreased lifecycle cost



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WELDABILITY

The alloy for Apex G2 HH rail was also designed to provide exceptional weldability. This allows the outstanding performance of Apex G2 HH to be utilized in track as welded with typical parameters. Weldability is shown numerically by the results of Jominy hardenability testing. Faster cooling rates are needed to form undesirable high hardness microstructures in comparison to conventional premium alloys.

Jominy End Quench Hardness Results

