



Advancement of Rail Wheelset Components and Performance

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MxV Wheel Research and Testing

Appreciation to MxV's Kerry Jones presenting this topic at the MxV Research Review.

MxV performs research on wheels for reasons of safety and to increase the life of wheelsets.



MxV Wheel Research and Testing

Each year, Car Repair Billing records indicate that wheelset replacements account for the highest percentage of repair billing.

For 2022, records indicate that wheelsets accounted for 49% of all car repair billing.



MxV Wheel Research and Testing

High performance wheels can offer improved safety and an extended life cycle.

Wheel tread damage is the single largest cause of wheelset removals. Wheel wear is another major factor limiting wheelset life.

Presentation Overview

- **Project objectives**
- **Review of damage modes**
 - Surface-initiated
 - Subsurface-initiated
- **High Performance Wheel (HPW) tests**
 - HPW2 at F.A.S.T.
 - HPW2 in revenue service
- **Observations from HPW tests**
 - Influence of properties
- **Concluding remarks**



Project Objectives

- Test High Performance Wheelsets, with wheels above Class C
- Determine which metallurgical properties optimize wheel performance.
- Extend service life of wheels
- Reduce number of Vertical Split Rims.



Wheel Damage Modes

Surface-initiated cracks:

- Steering tractions and thermal effects
- Can be detected visually
- Material loss can lead to high impacts



Wheel Damage Modes

Subsurface cracks:

- Detectable only by ultrasonic methods
- Surface damage, such as shelling, is not always present
- Could develop into potential wheel failure modes such as a Vertical Slit Rim, though these are rare





- HPW2 test phases:
- Laboratory testing complete
- On-track testing at F.A.S.T.
 - Began 2017
 - Ten similar cars, 40 test wheelsets
 - Loaded to 286,000 pounds
 - Three wheelsets per supplier
- Also testing in revenue service



HPW2 F.A.S.T. Removals

- Eight wheels removed for cause
- Average of 84,000 miles at FAST
- One removed for wear

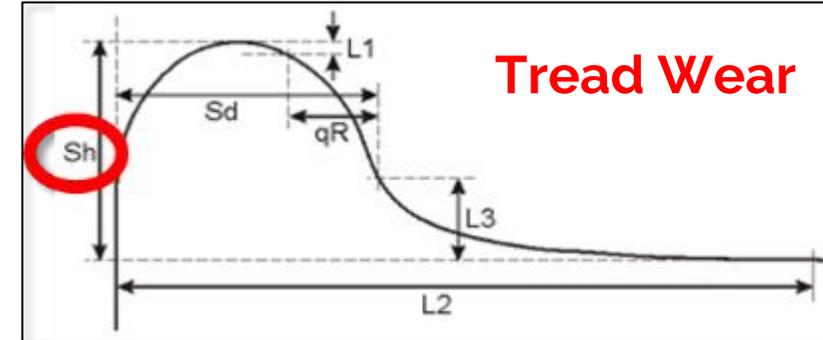
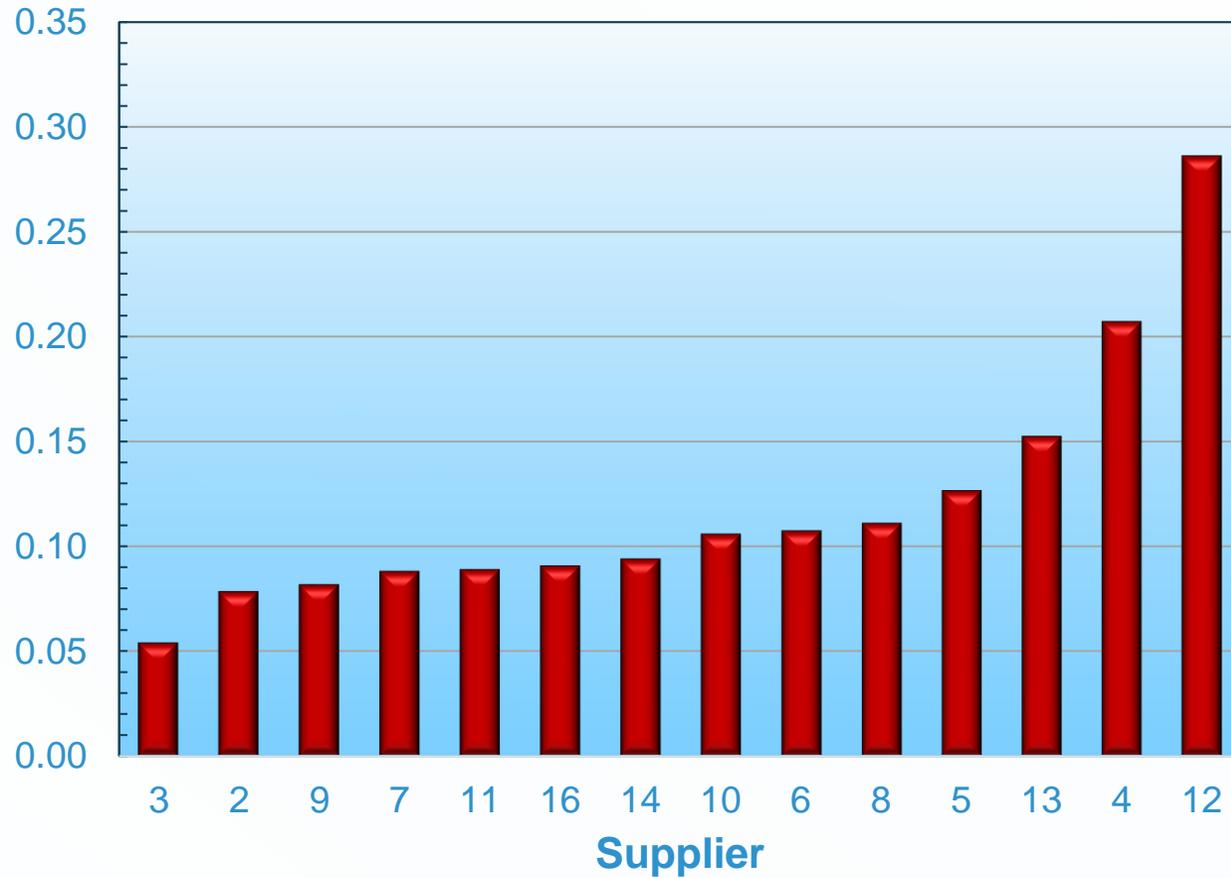
| Supplier | Cause | Mileage at Removal | Wheel Position |
|----------|---------------------------|--------------------|----------------|
| 3 | Subsurface fatigue cracks | 15,500 | 2 |
| 5 | Subsurface fatigue cracks | 17,300 | 4 |
| 5 | Subsurface fatigue cracks | 28,900 | 3 |
| 7 | Subsurface fatigue cracks | 25,300 | 1 |
| 13 | Subsurface fatigue cracks | 22,700 | 3 |
| 5 | Subsurface fatigue cracks | 31,800 | 4 |
| 7 | Subsurface fatigue cracks | 48,900 | 3 |
| 12 | Shattered rim | 63,700 | 4 |





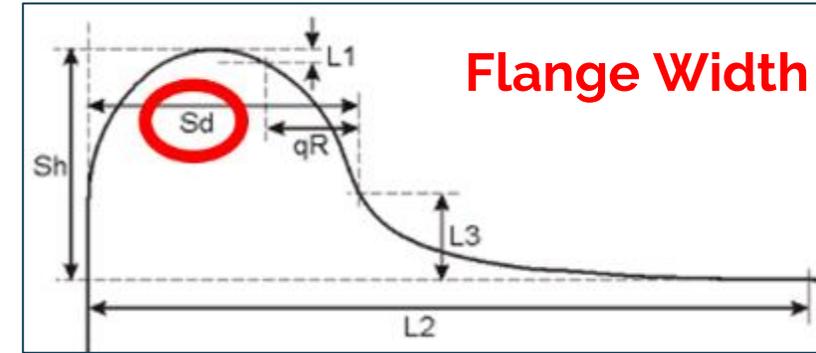
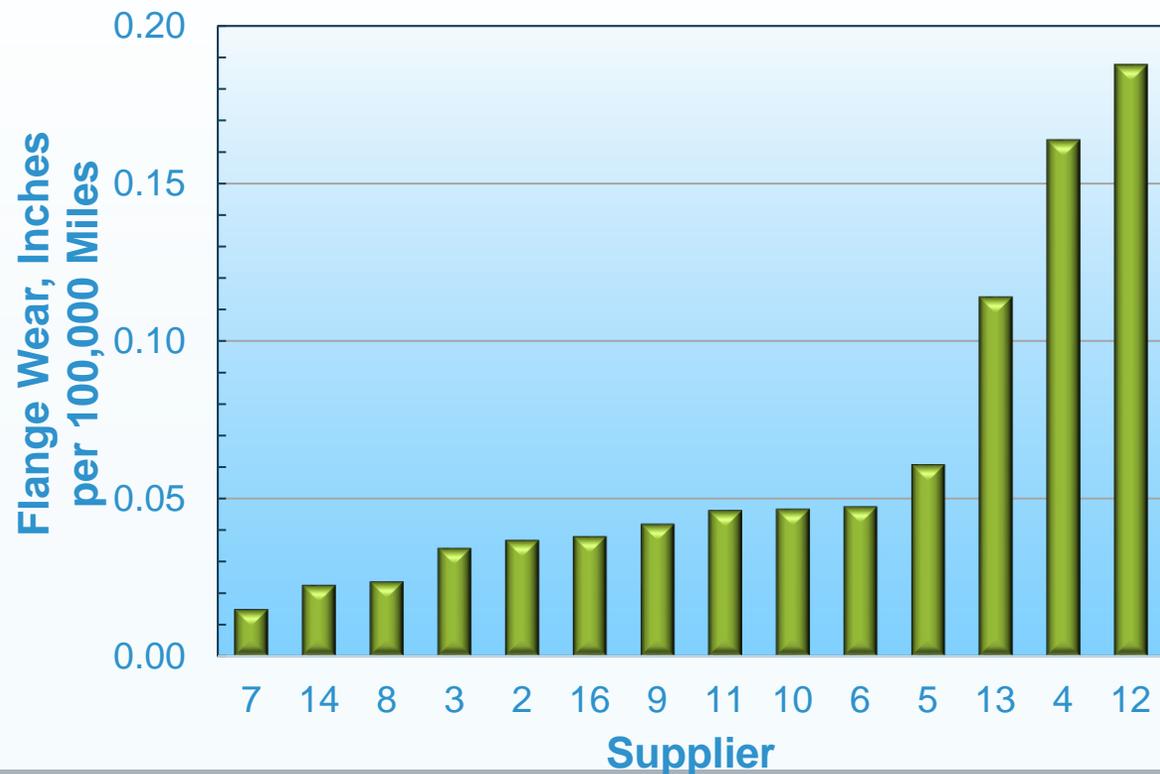
Tread Wear at F.A.S.T.

Tread Wear, Inches per 100,000 Miles



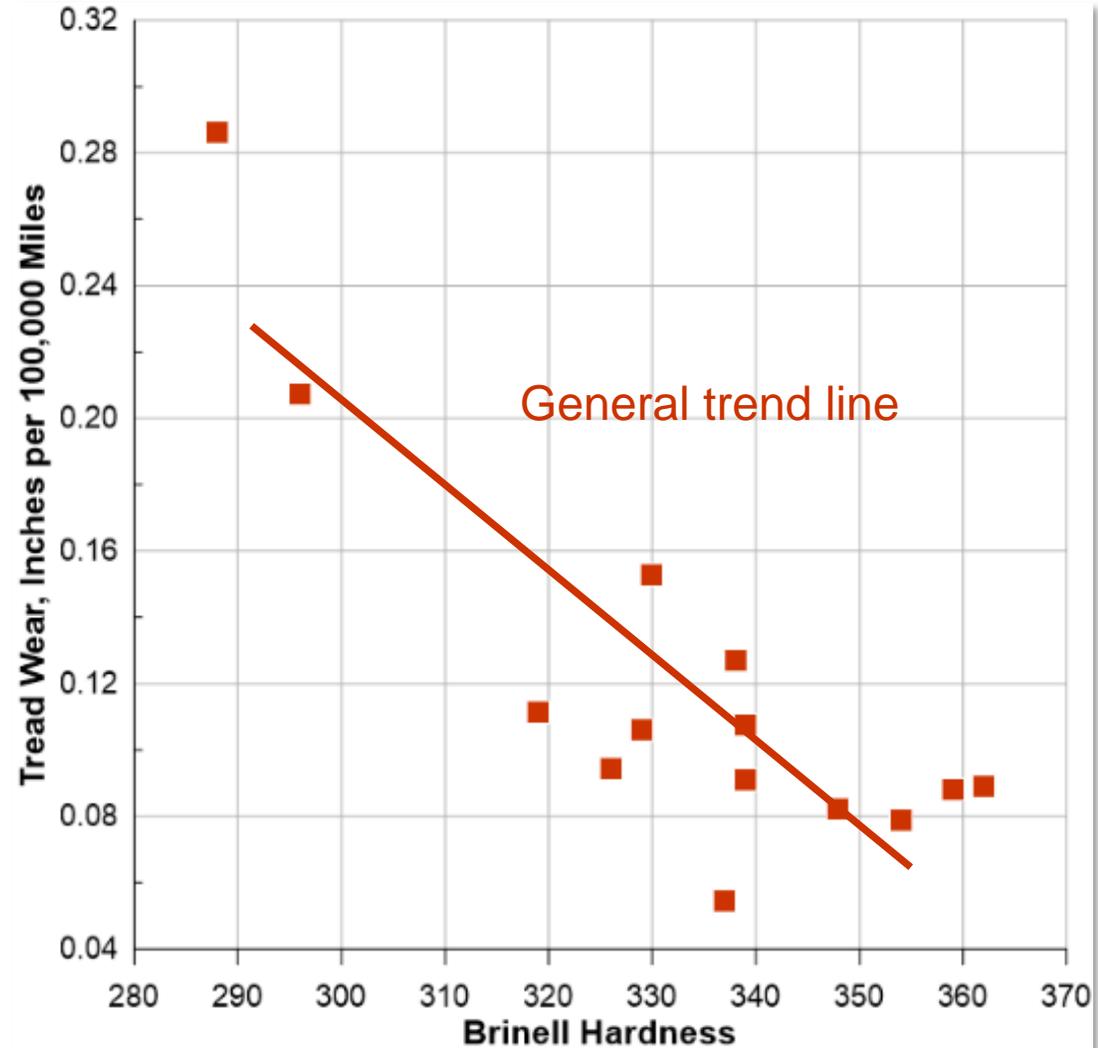
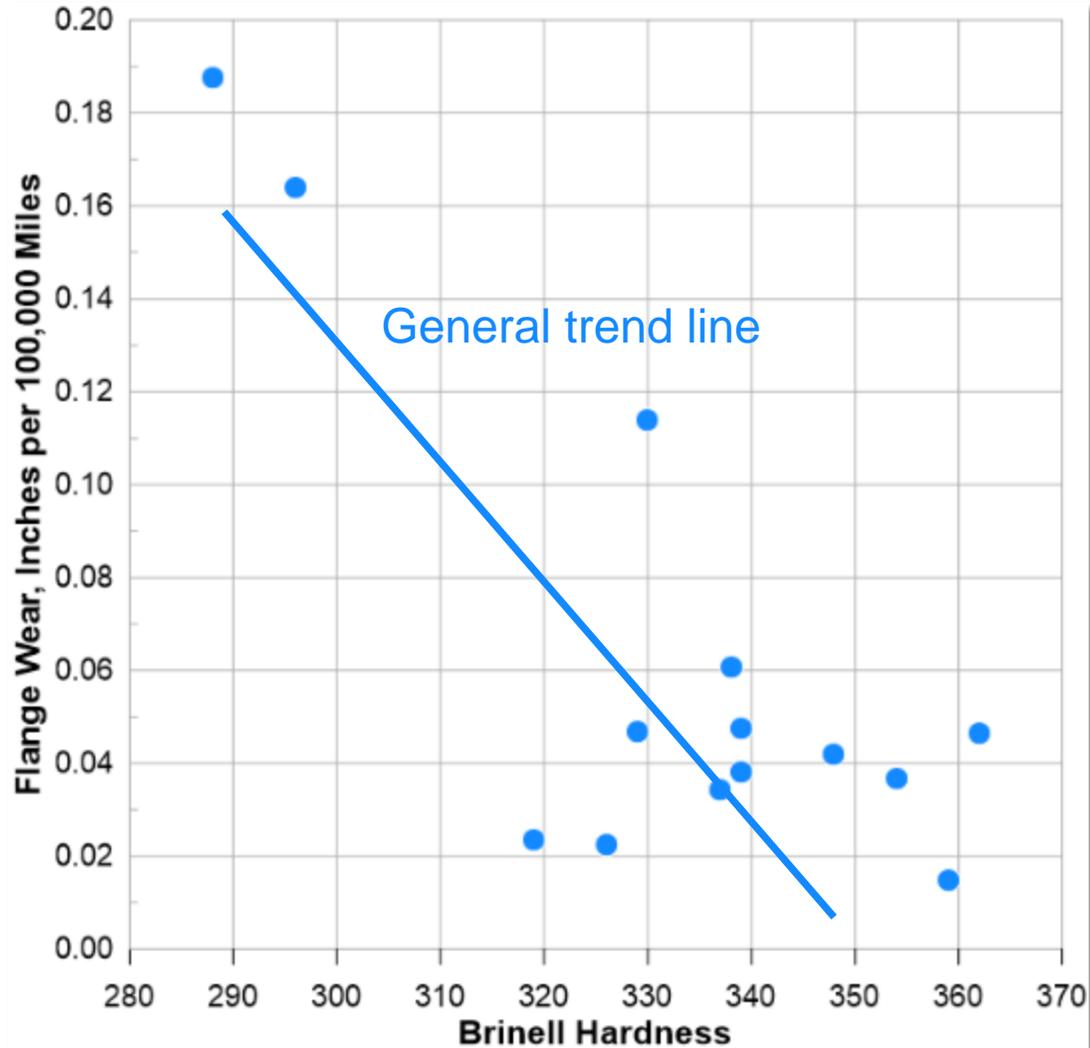


Flange Wear at F.A.S.T.





Wheel Wear at F.A.S.T.





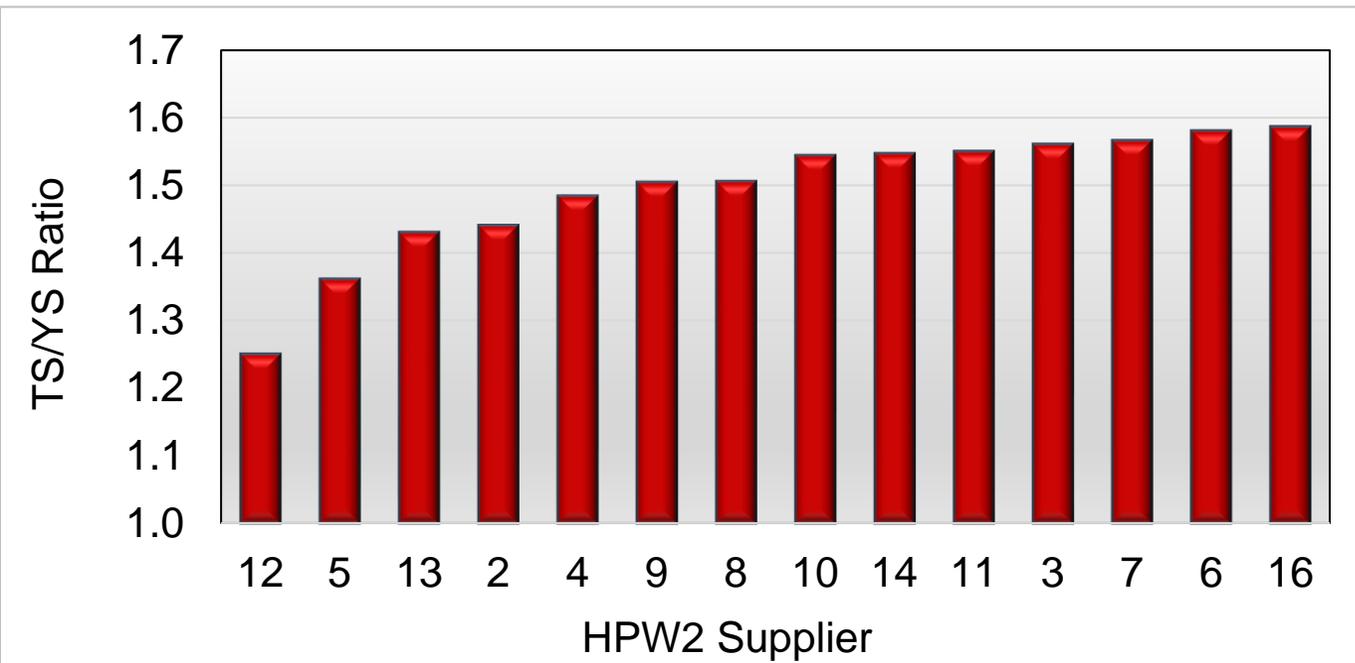
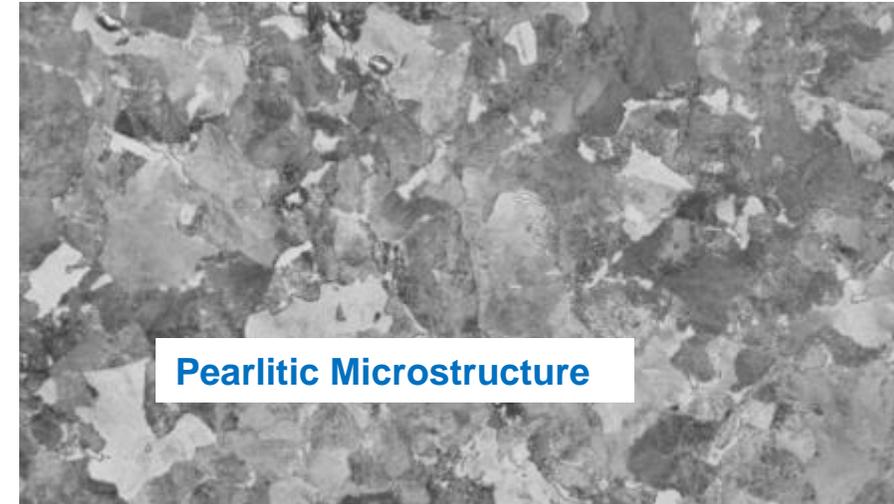
HPW2 Revenue Service Test

- **Six HPW2 manufacturers in this test**
 - 25 test wheelsets each
- **Class C – 100 sets**
- **No removals to date**
- **Visual, profile, and ultrasonic inspections in the spring of 2022.**
- **No inspections afterward because the cars are difficult to locate and inspect.**



Observations from HPW Tests

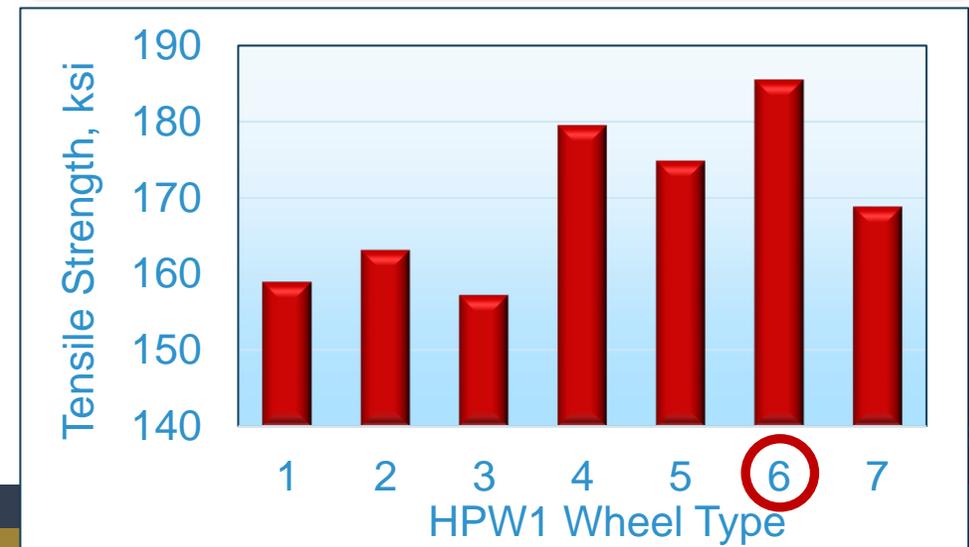
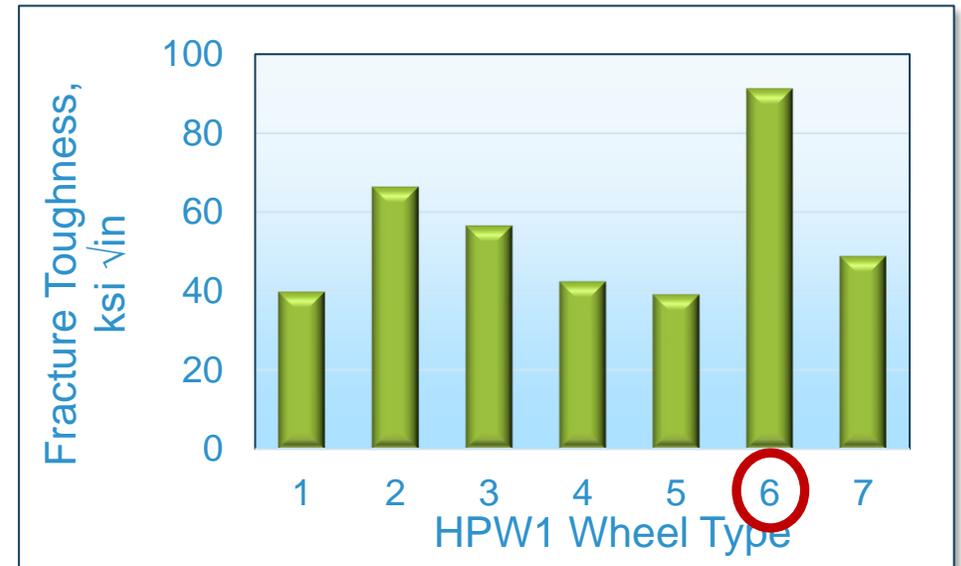
- **Many properties and parameters influence wheel life and performance**
 - Microstructure
 - Tensile to yield strength ratio
 - Microcleanliness





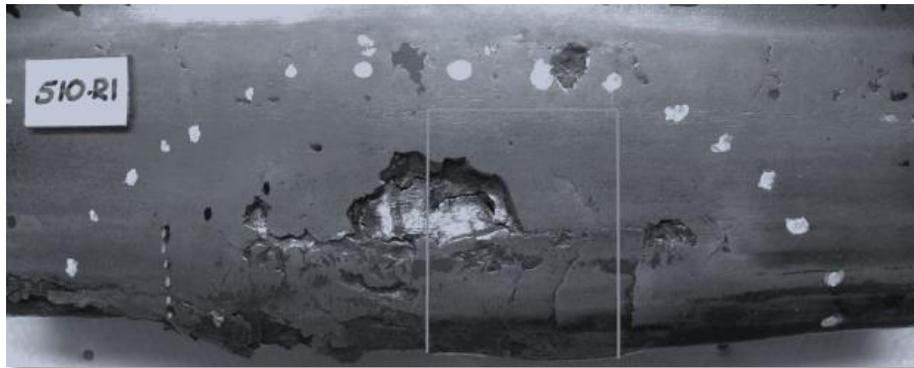
Observación: Microstructure

Both pearlitic/bainitic wheels exhibited excellent mechanical properties



Observación: Microstructure

In these tests, two steels with bainitic microstructure were submitted. Both bainitic steels had multiple early removals at FAST



Shattered rim under surface

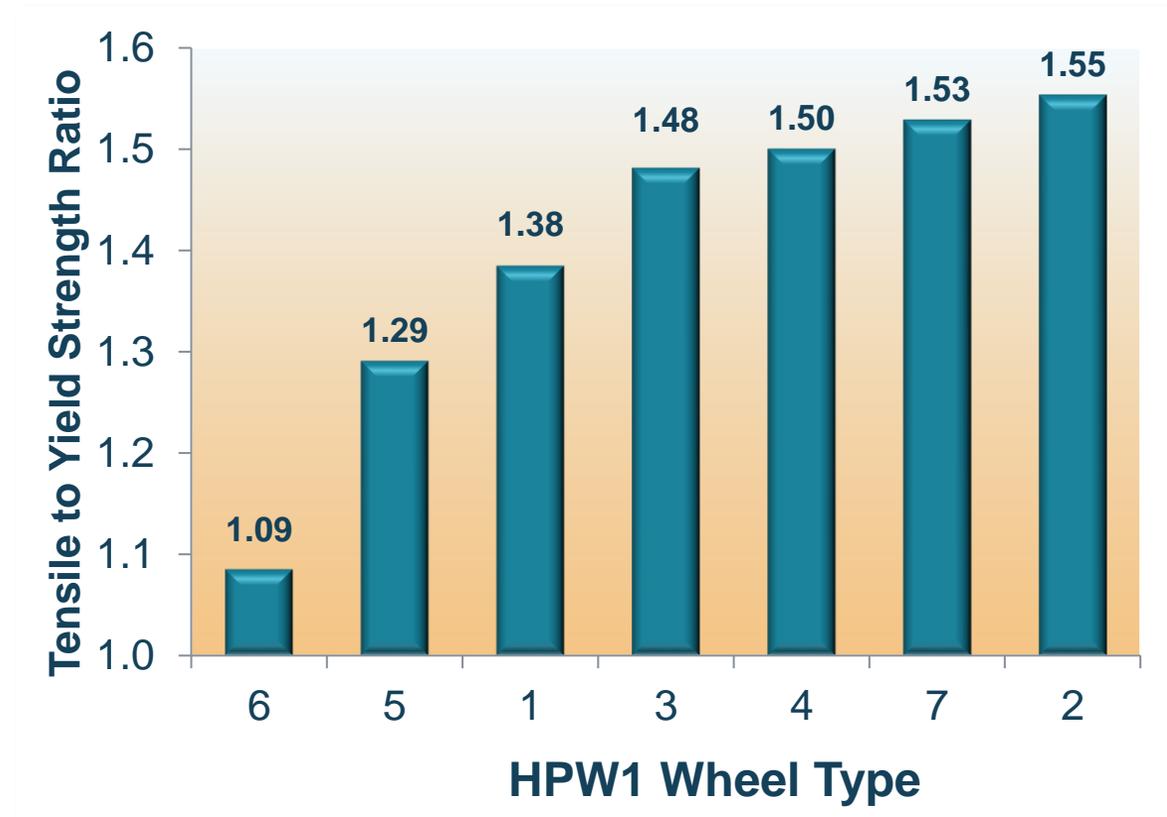
Subsurface crack bands





Observación: Tensile-to-Yield Strenght Ratio

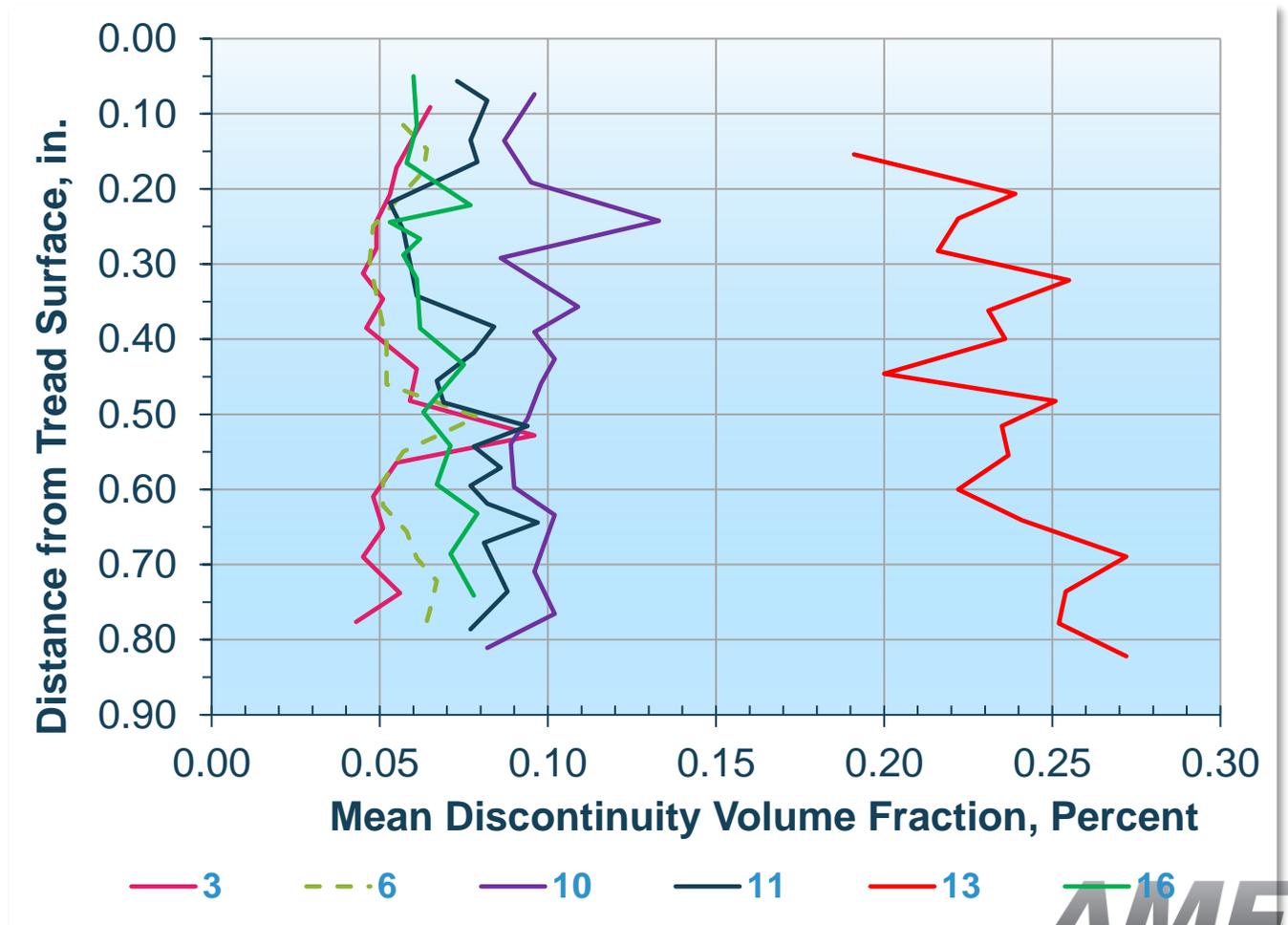
- Tensile-to-yield strength ratio is a measure of the amount of plastic deformation a material can undergo before fracture
- Generally, a higher value indicates higher resiliency
- Low ratio means yield strength and tensile strength are closer together





Observación: Microcleanliness

- Microcleanliness varies across manufacturers and processes
- HPW tests indicate that wheels are tolerant of voids and inclusions over a wide range of values





Resumen

- **HPW2 wheels continue to run at FAST**
 - Eight wheels removed for cracks in rim
 - Wear rate generally correlates with hardness
- **HPW2 wheels running in revenue service**
 - No removals
- **Wheel performance determined by multiple properties**
 - Bainitic wheels have not performed well in these tests
 - Tensile to yield strength ratio is not a definite predictor of performance, but low values did not perform well in these tests



Gracias. ¿Hay alguna pregunta?



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