



National Transportation Safety Board

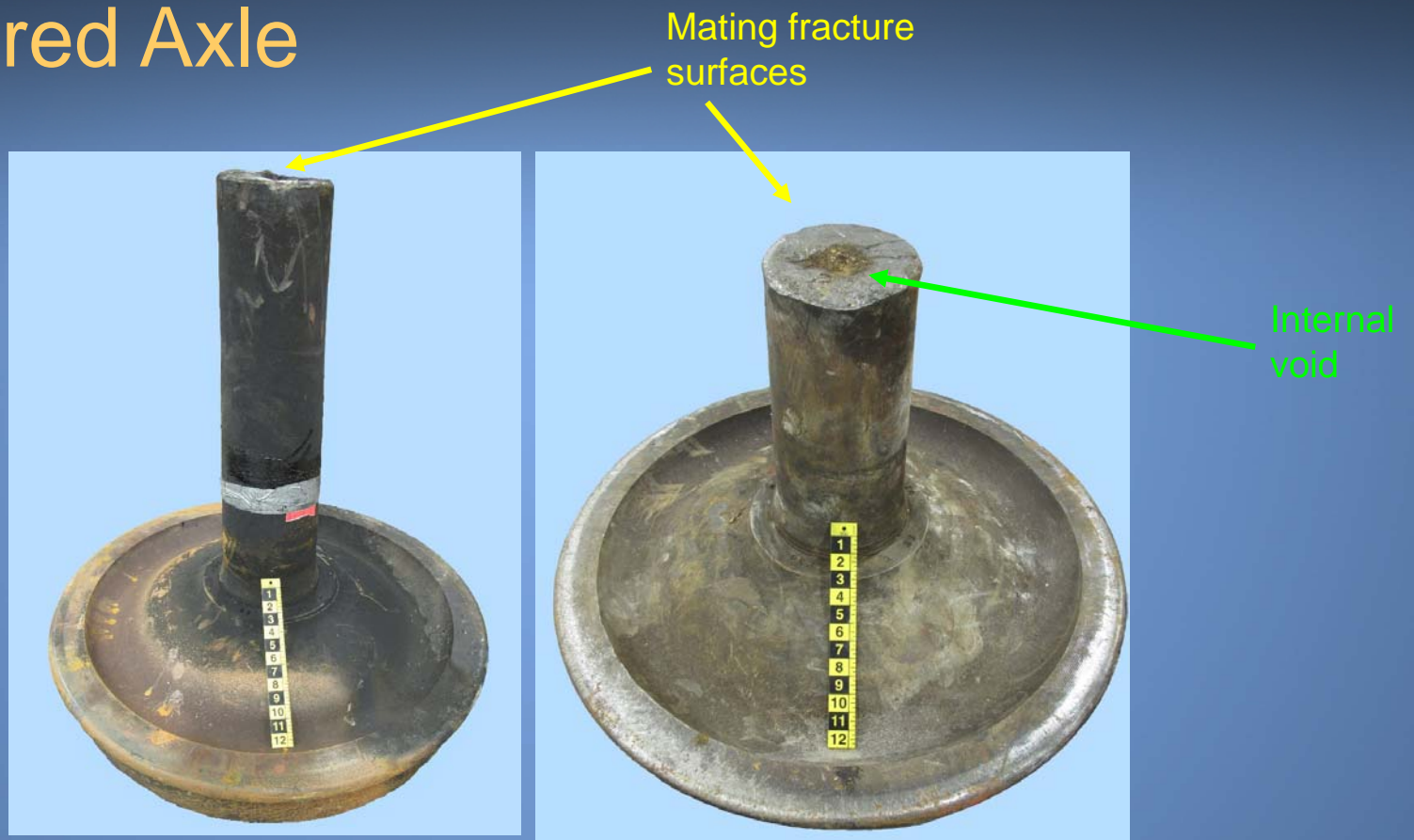
Grain Car Axle Failure Analysis

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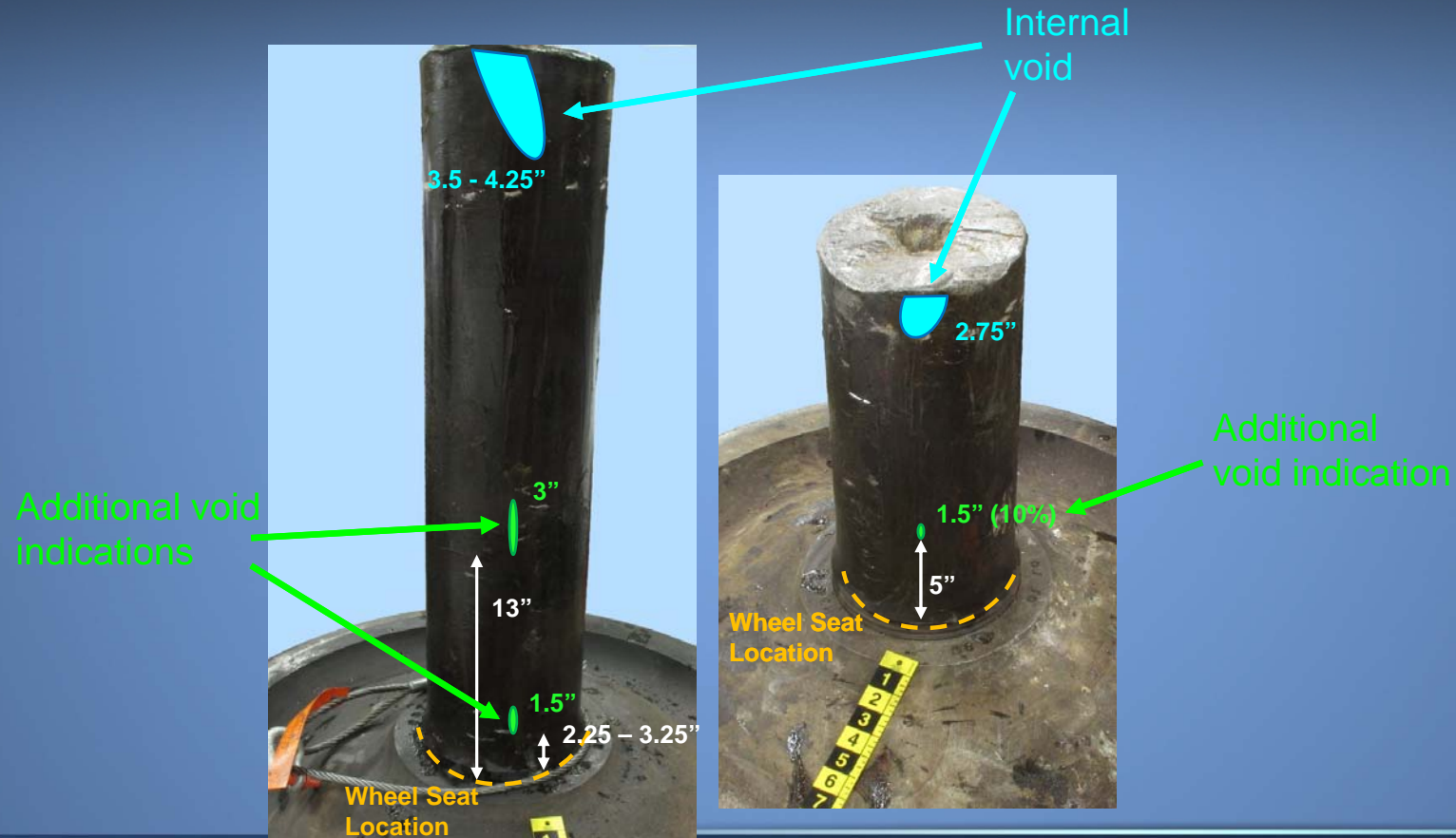
Overview

- Description of broken axle
- Non-destructive testing of axle
- Axle failure mechanism
- Cause of the axle failure

Fractured Axle



Non-Destructive Testing of the Axle

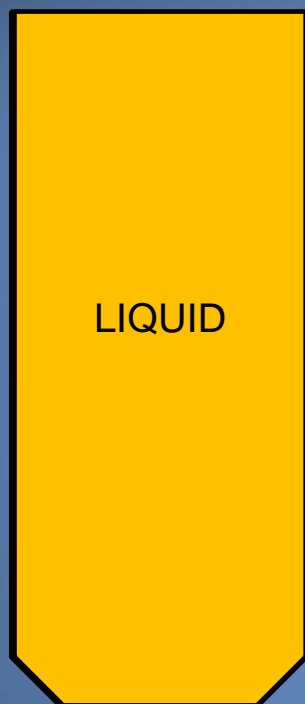


Axle Fracture Surface

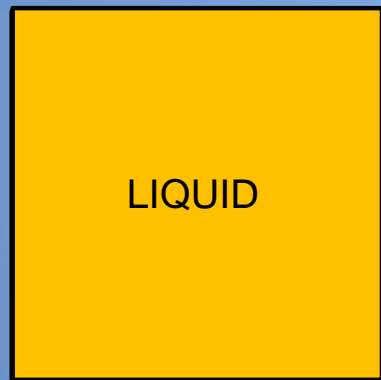
- Two distinct fracture regimes
 - Fatigue
 - Overstress
- Crack propagation from inside void to outside
- Heavy batter and post-fracture damage



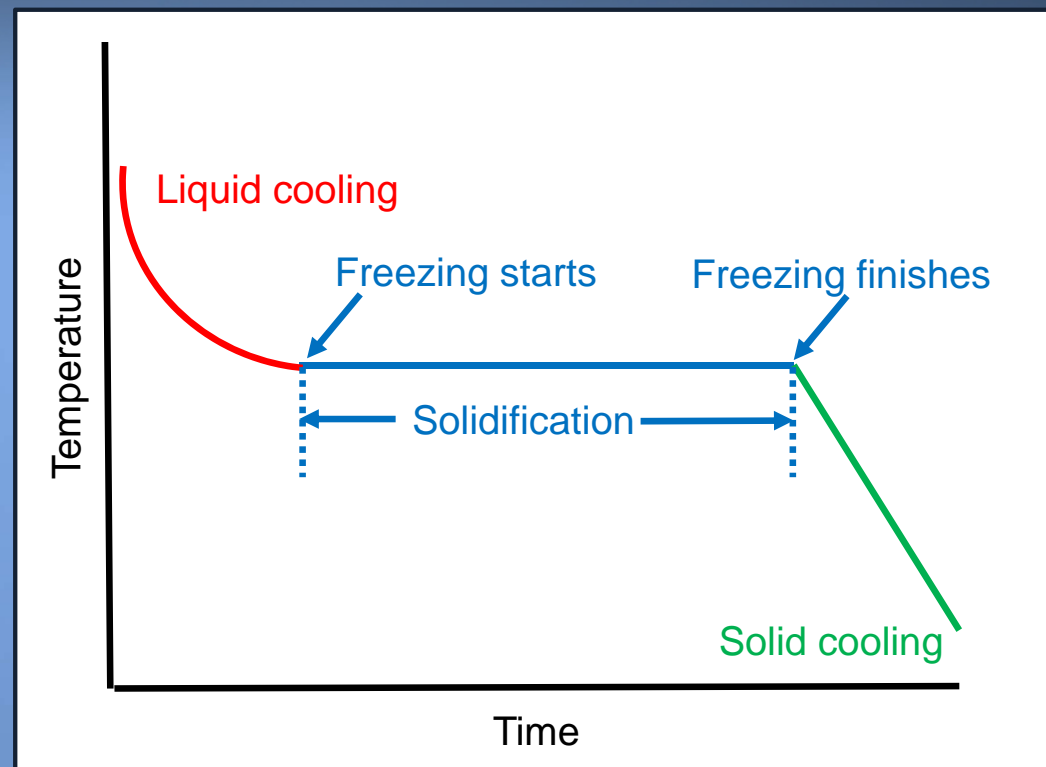
Formation of Internal Voids



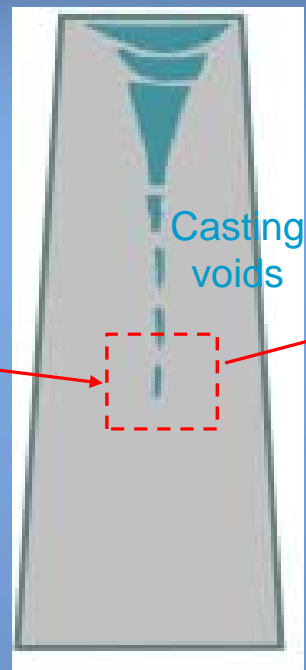
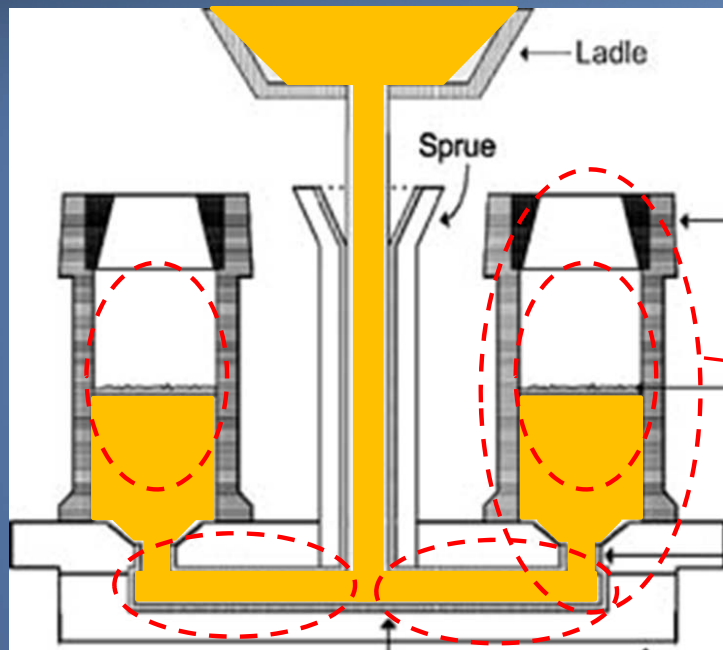
Mold Side View



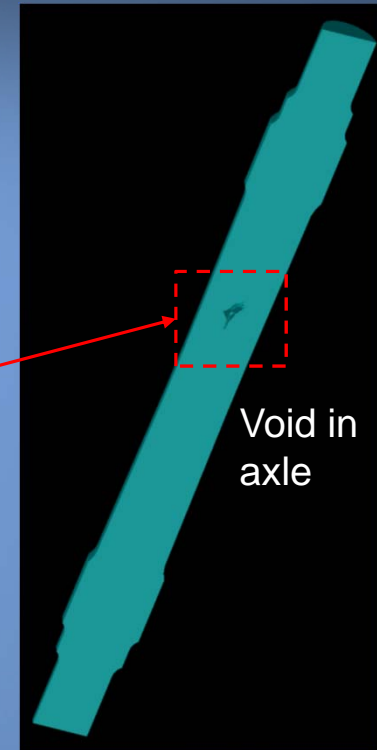
Mold Top View



Formation of Internal Voids



Steel ingot



Steel axle

Summary

- The wheelset axle fractured from fatigue
 - Crack initiated at an internal solidification void
 - Crack propagated toward outside surface of axle
- Void was created during initial ingot casting
- Proper ultrasonic testing should have detected void
 - Performed at manufacture
 - Performed at rework



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