

# MATERIAL BEHAVIOUR IN WHEEL-RAIL CONTACT

## OVERVIEW

The behaviour of wheel and rail materials under wheel-rail contact involves the following deterioration mechanisms:

- wear
- plastic deformation
- rolling contact fatigue

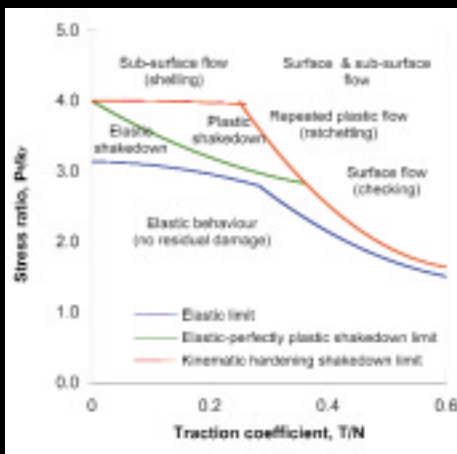
An understanding of the respective mechanisms, and the role of both material properties and wheel-rail contact conditions, is critical in achieving improved component performance, particularly under more demanding loading conditions (curved track and heavy haul).



Surface-initiated rolling contact fatigue in rail: heavy haul



Transverse defects in rail: mass transit



Shakedown diagram for mixed rolling-sliding contact

## WHEEL-RAIL CONTACT CONDITIONS & MATERIAL CHARACTERISTICS

Contact between wheel and rail involve mixed rolling and sliding conditions, the severity of which is influenced by vehicle and track parameters such as axle loads, profiles, bogie design and track curvature.

Material characteristics of relevance include:

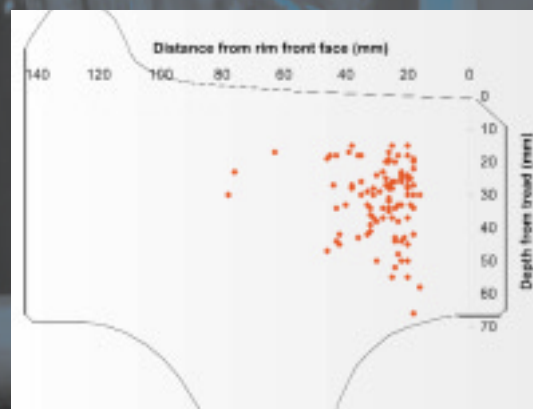
- strength or hardness
- ductility
- cleanliness (non-metallic inclusion content)

The relationship between contact conditions and material properties is represented non-dimensionally in the shakedown diagram, which provides a design framework for the selection of material properties and wheel-rail profile development.

## RESEARCH PROGRAM

Research activities cover:

- determination of material characteristics (microstructure, cleanliness, mechanical properties);
- measurement of material behaviour under simulated service loading (cyclic deformation, wear);
- assessment of as-supplied components (rails and wheels)
- monitoring of in-service performance.



Wheel cleanliness assessment using ultrasonic testing

## BENEFITS

- Establishment of minimum rail material requirements:
- avoid corrugation development
- minimise rolling contact fatigue & wear damage
- Minimum material cleanliness requirements to avoid wheel shelling (heavy haul)