Wayside Detection
The Detroit Edison Experience

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Discussion Topics

- The Detroit Edison Strategy
- WILD Issues
- Financial Issues
- Conclusions and Recommendations
Wheel Failures and WM Codes

- WM 66, Flange Cracked or Broken
- WM 68, Cracked Rim
- WM 71, Shattered Rim
- WM 72, Spread Rim
- WM 83, Cracked Plate
- WM 75, Shelling, Spalling, Thermal-Mechanical
- WM 65 and 67, Out of Round (WILD or Gage)
- WM 76, Built-Up Tread
- WM 78, Slid Flat
Recent AAR Rule Changes

- WM 65 Wheel Impact Load Detector Removal at Impact Greater Than 90 Kips

- 97% of the Benefit Falls to Class I RR’s

- Rim Thickness Credit – Removed

- Window of Opportunity - Stress State
The Detroit Edison Strategy

- The Theory
- The WILD Program
- 50+ Kip Maintenance Strategy
The private car owner can effectively manage the life and performance of heavy haul-high mileage wheel sets, by developing a proactive maintenance strategy based upon way-side detection methodologies in combination with Class I Railroads, private railcar maintenance providers, and railway suppliers.
The WILD Program

- Data Purchased from TTCI
- By Train
- By Railcar
- By Wheel Location
- By Graph
- Proactive Maintenance Strategy
WILD Data

WILD data for empty DECO unit trains & loaded coal cars
## Selection Criteria

- Destination: ALL
- Loaded/Empty: All
- Railroad: ALL

## Active Trains with Latest Loaded KIPS Readings

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<th>Ship Date</th>
<th>Unit Train#</th>
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### Car Details

**Car Details for:** MV, 04/30/2004 16:38

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**WILD info shown for Car:** DEEX005392, 01/24/2004 12:19

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**# of Cars:** 98

**Maintenance and Mileage**
50+ Kip Maintenance Strategy

- Wheels Replaced Above 85 kips (3Pt. MA)
- 50+ Kips - Complete Visual Inspection
- Install Cobra Tread Guard Brake Shoes
- Computerized SCAT and Date Stencil
- Constant Contact Measurement
50+ Kip Maintenance Strategy

- Brake Beam & Polymer Slides
- Springs & Truck Mechanisms
- Re-torque Bolts - Air Valve & Structural
- Inspect Relief on Bearing Adaptors
- AAR Condemnable Criteria (1/8 WM 64)
- Modified NCTA Wheel Specification
# Wheel Life Trend Analysis

<table>
<thead>
<tr>
<th>Without 50+ Kip Strategy</th>
<th>With 50+ Kip Strategy</th>
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<tbody>
<tr>
<td>01/01/03…11/14/03</td>
<td>11/15/03…12/31/03</td>
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<tr>
<td>80 Randomly Selected Wheel Sets</td>
<td>102 Randomly Selected Wheel Sets</td>
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Individual Value Plot of pre life span, post life span
Scatterplot of MAX_VERT vs TRAIN_DATE
( Wheels without 50 kips strategy performed )
WILD Issues

- WILD Calibration: Frequency & Uniformity
- Effects of Train Speed
- Effects of Track Structure & Sub-grade
- Effects of Concrete Ties
- WILD Reading Variation
- Etc.
Pareto Chart of WHYMADE since 2003

<table>
<thead>
<tr>
<th>WHYMADE</th>
<th>Count</th>
<th>Percent</th>
<th>Cum %</th>
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Chart of WHYMADE since 2003.
Scatterplot for DEEX990896

Y-Data
110
100
90
80
70
60
50
40
30

Variable   CAR_NAME
- 3pt mavg DEEX990896
- MAX VERT DEEX990896

Train Date
1-Jul-04 1-Apr-04 1-Jan-04 1-Oct-03 1-Jan-04 1-Apr-04 1-Jul-04
Hypothesis

- Kips variation vs. Speed change?
- Kips variation vs. Car weight?
- Kips variation vs. Site change?
Fitted Line Plot - Kips differential vs. Speed differential

\[ kips \text{ var} = 0.4216 + 0.7021 \text{ spd \ var} + 0.003853 \text{ spd \ var}^2 + 0.000354 \text{ spd \ var}^3 \]

- \( S = 14.2426 \)
- \( R-Sq = 10.9\% \)
- \( R-Sq(\text{adj}) = 10.8\% \)
Fitted Line Plot - Kips differential vs. Car Weight differential

\[ \text{kips var} = 0.5704 + 0.3448 \text{ weight var} \\
+ 0.006886 \text{ weight var}^2 + 0.000047 \text{ weight var}^3 \]

- Parameter S: 15.0006
- R-Sq: 1.1%
- R-Sq(adj): 1.1%
Observations

- Kips variation vs. Speed variation – small correlation.

- Kips variation vs. Weight variation – none.

- Kips variation vs. different sites – small correlation.
Precision & Accuracy

Target Analogy

I. Precise, not accurate

II. Accurate, not precise

III. Precise and accurate
Step 4: Analyzing Gage R&R Results

A. R&R% of Tolerance

1. R&R less than 10%—Measurement System “acceptable”

2. R&R 10% to 30%—May be acceptable—make decision based on classification of Characteristic, Application, Customer Input, etc.

3. R&R over 30%—Not acceptable. Find problem, re-visit the Fishbone Diagram, remove Root Causes. Is there a better gage on the market, is it worth the additional cost?
Measuring gage tolerance vs. Process tolerance example

- Process Tolerance = +/- 7.5 kips, 70 – 85 kips.

- Measurement Tolerance is 1/10th of Process Tolerance, = +/- .75 kips.
Scatterplot of kips variation vs. train date
Financial Impact

- WM 65, 67 and WM 75
- Wheel Changes 2002, 2003 and 2004
- 2002  65-0   67-490  75-1,279 **Total - 1,769**
- 2003  65-938  67-80    75-1,179 **Total - 2,179**
- 2004  65-973  67-19    75-1,013 **Total - 2,005**
- AAR Labor Rates per wheel switch $1,000.00
  - Total Cost 2002 - $1,769,000
  - Total Cost 2003 - $2,179,000
  - Total Cost 2004 - $2,005,000
Financial Impact

- Train days lost equals number of wheels pulled.
- One train cycle equals seven days (52 cycles per train per year)
- Total number of cycles lost
  - 2002 - 253 (5 sets)
  - 2003 – 311 (6 sets)
  - 2004 – 286 (5.5 sets)
- At current lease rates ($500 pcpm), cost to Detroit Edison is approximately $3,600,000.00
Summary

- The 50+ Kip Strategy Extends Wheel Life.

- WM65 Exhibits Shortest Life Span.

- What’s the contribution of variation by the measuring system? - What are the variation contributions from the Repeatability & Reproducibility tests of the measuring devices?
Recommendations

- Root Cause of Wheel Defects WM 65 & WM 75
- Computerized SCAT at All Repair Tracks
- Rail Maintenance Management Forum
- WILD Calibration Should be Standardized and Meet AAR M-1003 Quality System
- Improved Efforts to Share Costs and Benefits Within the Railroad Industry
- Private Railcar Owner - Voting AAR Member
Our greatest challenge as an industry is to get the departments responsible for the vehicle performance and the track maintenance to work together and define a wheel rail interaction strategy to obtain synergy between the vehicles, track and the long term profitability of the heavy haul operation.

Source: International Heavy Haul Association (2001)