



Transportation Technology Center, Inc., a subsidiary of the Association of American Railroads



AAR QA-5000 and Other Developments

October, 2015

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What's new in the prairies of TTCI

- ◆ **AAR QA-5000 Program**
- ◆ **Rolling Contact Fatigue Simulator (RCFS)**
- ◆ **Truck Research**
- ◆ **Crude by Rail Training**





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AAR QA-5000 Program

AAR M-1003 Quality Assurance Specification

◆ What is it?

- Railroad industry standard for a quality assurance program for products sold for North American use

◆ Why do we use it?

- Started with journal roller bearings
- Catastrophic failures decreased 50% after M-1003 initiated

◆ What's its history?

- Companies want the certification to give the industry the confidence in their products
- Increases safety and reduces costs

1985

1-Component

2-Auditors

Today

133-Components

47-AAR Auditors

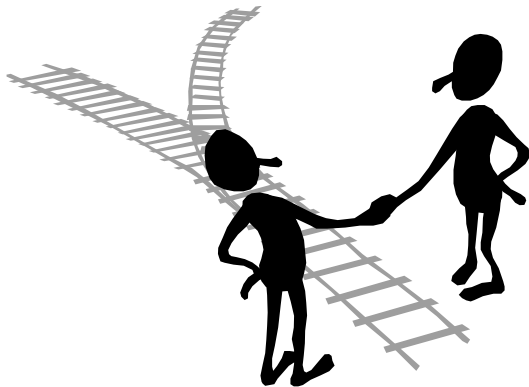


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TTCI M-1003 Quality Assurance Certification

- ◆ AAR requires companies that perform activities (commodities) that are listed on appendix “A” **must** become M-1003 certified
- ◆ Companies that perform activities that are not listed on appendix “A” may become certified as “**voluntary**”
 - Same requirements as appendix “A” listed products or services
 - Same audit requirements
 - Same timeframe structure, etc.
 - Want to show proof they have a proven “Quality Program”





North American M-1003 Quality Processes

Approved design

- ◆ Approved by AAR Technical Committees
- ◆ Commodity-by-commodity basis

Approved Manufacturing Process

- ◆ Approved by AAR Technical Committees
- ◆ Commodity-by-commodity basis

Approved Quality Process

- ◆ Physical audit of all 24 elements of M-1003
- ◆ Performed by the QA Auditors

Trial run of parts for some components

- ◆ May be required by Technical Committees
- ◆ Commodity-by-commodity basis

QA Committee approval

- ◆ Approved by AAR QA Committee

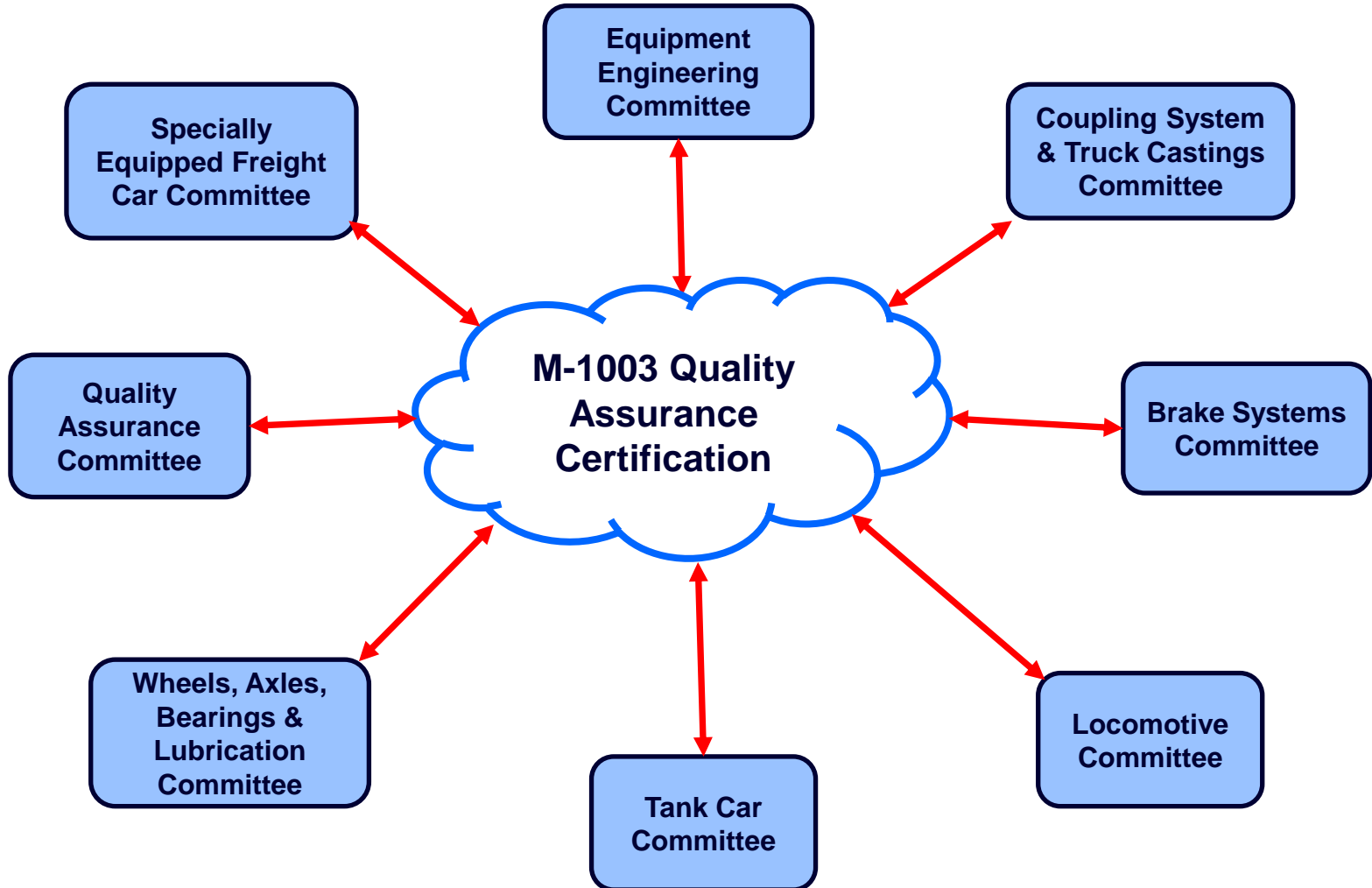
Ongoing monitoring

- ◆ Approved by AAR QA Committee YEARLY AUDIT
- ◆ Uses MSRP Non-Conformance Process
- ◆ May also be required by Technical Committees YEARLY INSPECTION





AAR Technical Committee Requirements to the M-1003 Quality Assurance Program



AAR QA – 5000 Program



AAR QUALITY ASSURANCE COMPLIANCE PROGRAM

IMPROVING THE SAFETY AND PRODUCTIVITY OF RAIL TRANSPORTATION

The AAR QA Compliance Program, QA 5000, offers the same high level of audit performance as the M-1003 Certification procedures.

While the M-1003 process is valid for manufacturers who supply their products in North America, it does not cover the quality of railroad products not intended for North America. The AAR QA Compliance Program meets this growing need.

The AAR QA Compliance Program includes evaluation of a company's quality system, including an audit. This compliance can be granted to manufacturers of many products, including:

- Roller Bearings
- Couplers
- Bogies (trucks)
- Cushioning Devices
- Wheels
- Axles
- Brake Components
- Freight Cars



AAR QA – 5000 Program

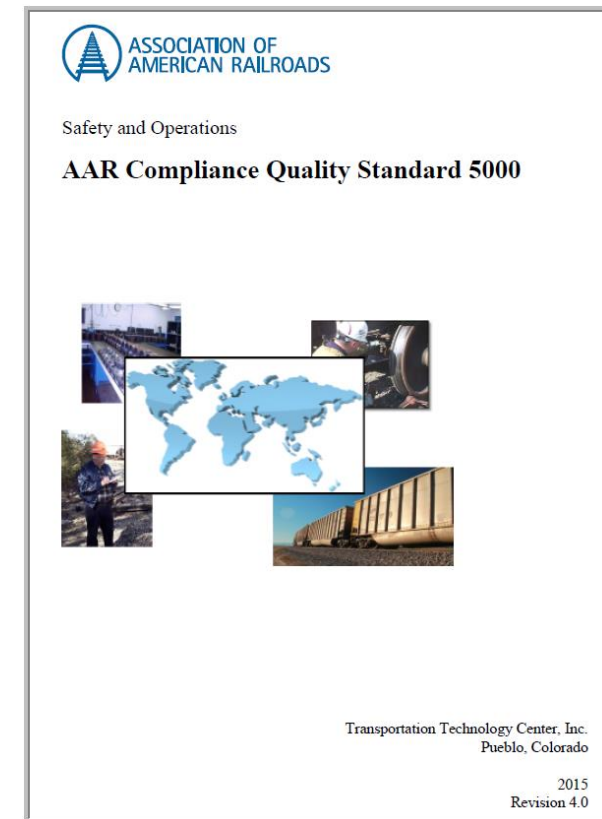
Created to fill a void and answer requests for AAR QA certification for companies and products **NOT** intended for North American Rail Interchange Service. Duplicates the QA M-1003 process, with exceptions.

Key similarities to M-1003:

- Audit methods
- All 24 elements audited
- Company internal quality manual and auditing

Key differences:

- No AAR Committee Involvement
- Does not include non-conformance reporting and feedback system
- Involves a subset of M-1003 Commodities
- Does not involve link to technical approval requirements (design, performance, test, manufacturing)



M-1003 vs. QA-5000

AAR Certification to M-1003

AAR Compliance to QA-5000

- ◆ Approved by AAR Technical Committees
- ◆ Commodity-by-commodity basis

Approved design

- ◆ No design approval

- ◆ Approved by AAR Technical Committees
- ◆ Commodity-by-commodity basis

Approved Mfg Process

- ◆ No Manufacturing Process approval

- ◆ Physical audit of all 24 elements of M-1003
- ◆ Performed by the QA Auditors

Approved Quality Process

- ◆ Physical audit of all 24 elements of M-1003
- ◆ Performed by the QA Auditors

- ◆ May be required by Technical Committees
- ◆ Commodity-by-commodity basis

Trial run of parts for some components

- ◆ Not required

- ◆ Approved by AAR QA Committee

QA Committee approval

- ◆ Approved by Chief Technical Standards

- ◆ Approved by AAR QA Committee
- ◆ Uses MSRP Non-Conformance Process

Ongoing monitoring

- ◆ Not required

AAR QA – 5000 Program



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Rolling Contact Fatigue Simulator

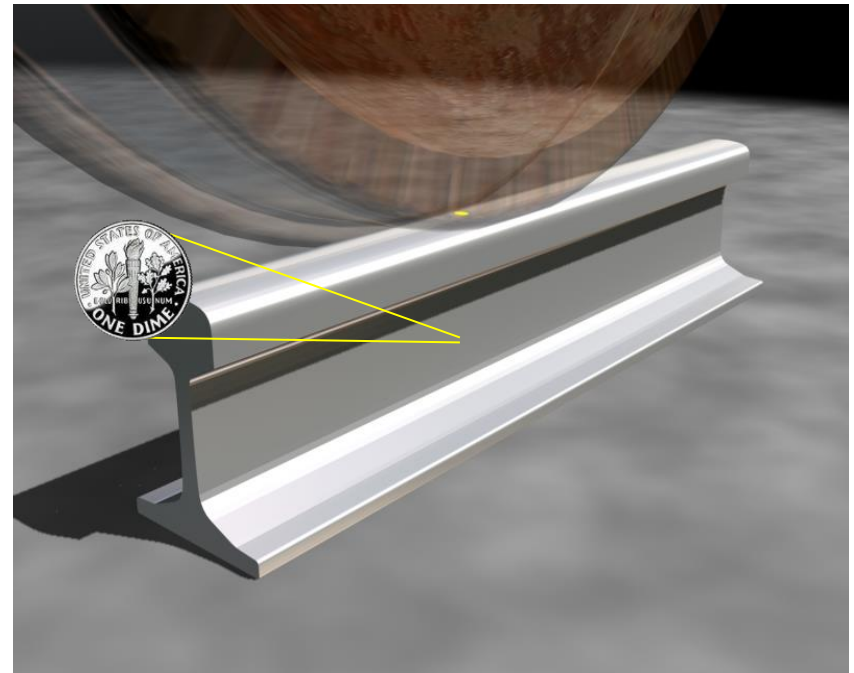
TTCI Rolling Contact Fatigue Simulator (RCFS)

◆ Background

- RCFS is a unique research facility to initiate fatigue related defects in the wheel/rail interface under various operating conditions of heavy axle load freight applications as well as passenger research.

◆ Rolling Contact Fatigue (RCF) results in:

- Reduction in the life of both wheels and rails
 - Crack formation (rail spalling, shelling, high impact wheels)
 - Wear (gage corner / flange, head / tread)
 - Material flow
- in both wheel & rail

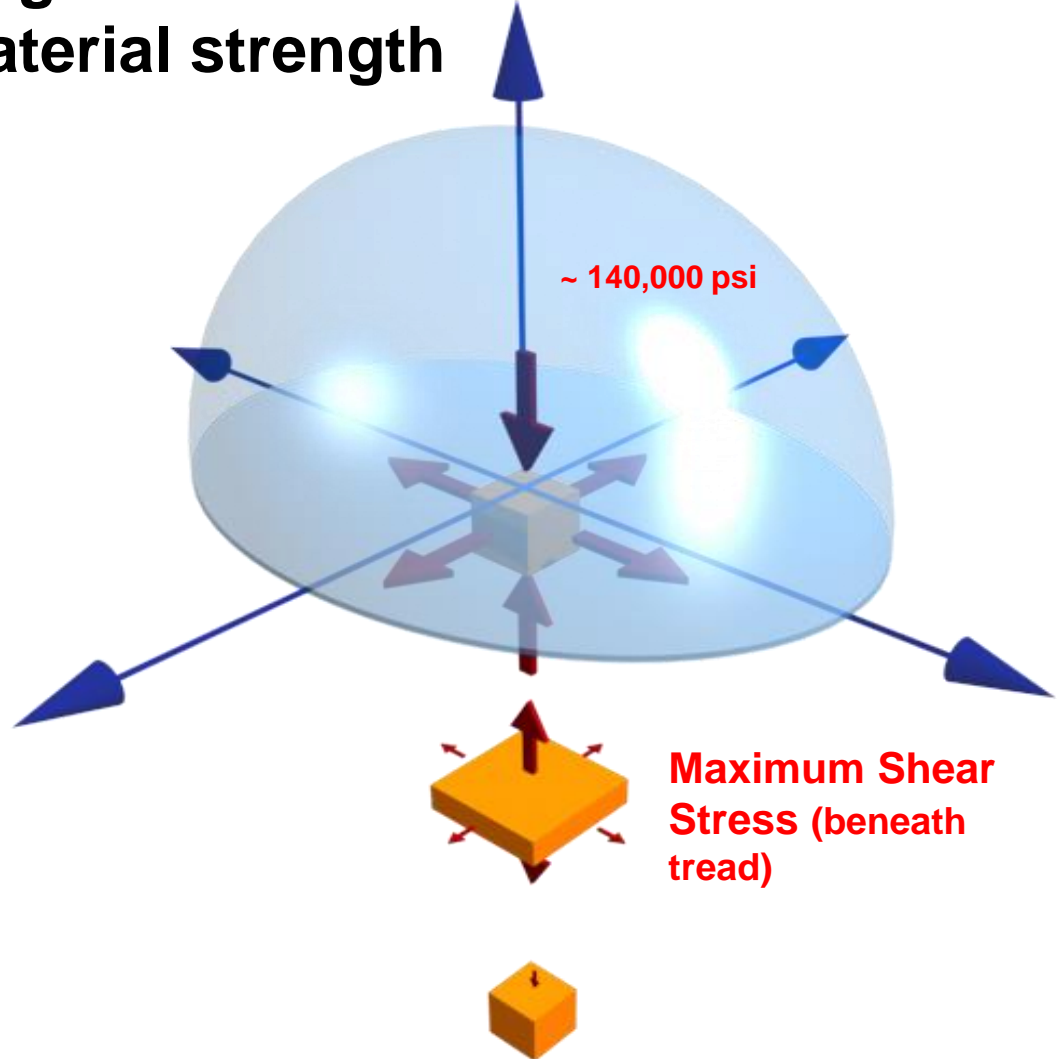


TTCI Rolling Contact Fatigue

◆ Rolling Contact Fatigue is caused when external stresses exceed material strength

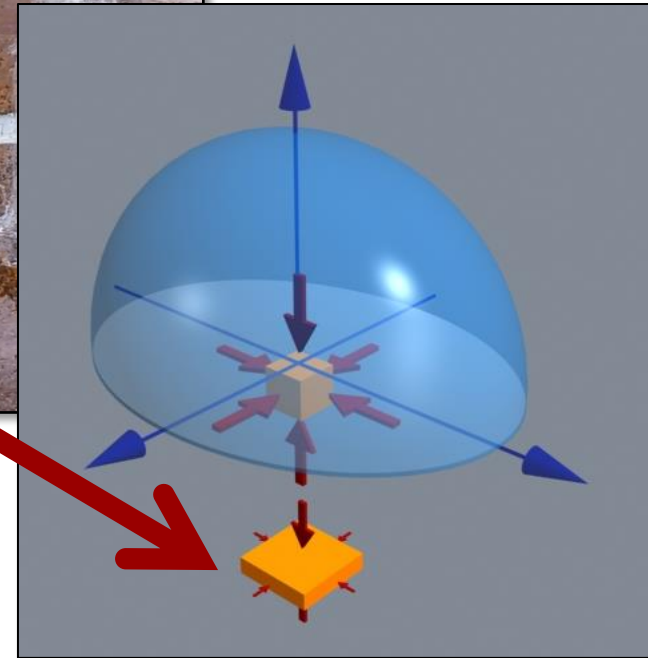
◆ Drivers

- Vertical loads
- Area of contact patch (wheel & rail profiles)
- Surface tractions
- Material strength & cleanliness



TTCI Rolling Contact Fatigue - Wheels

- ◆ Tread damage attributed to the maximum shear stress
 - Material breaks out at depth of maximum shear stress



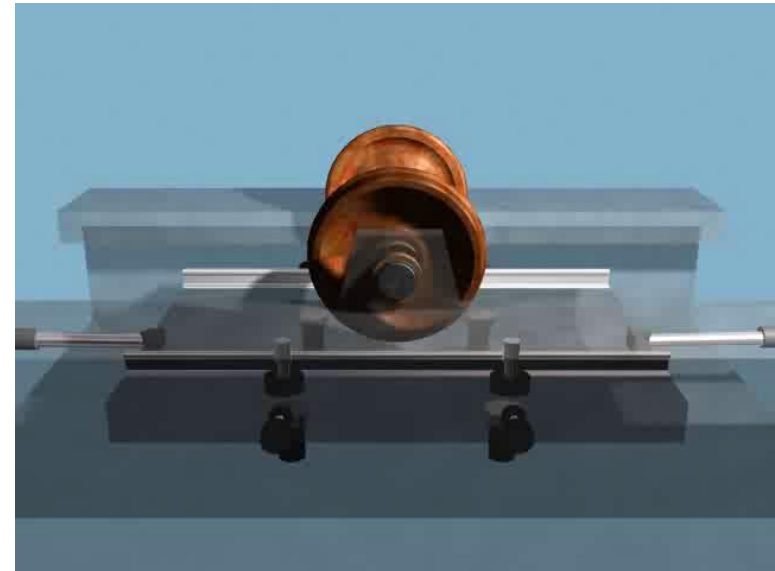
Rolling Contact Fatigue

- ◆ **Wheel damage is reflected in the rail, resulting in:**
 - Grinding
 - Replacement



RCF Simulator – Unidirectional Operation

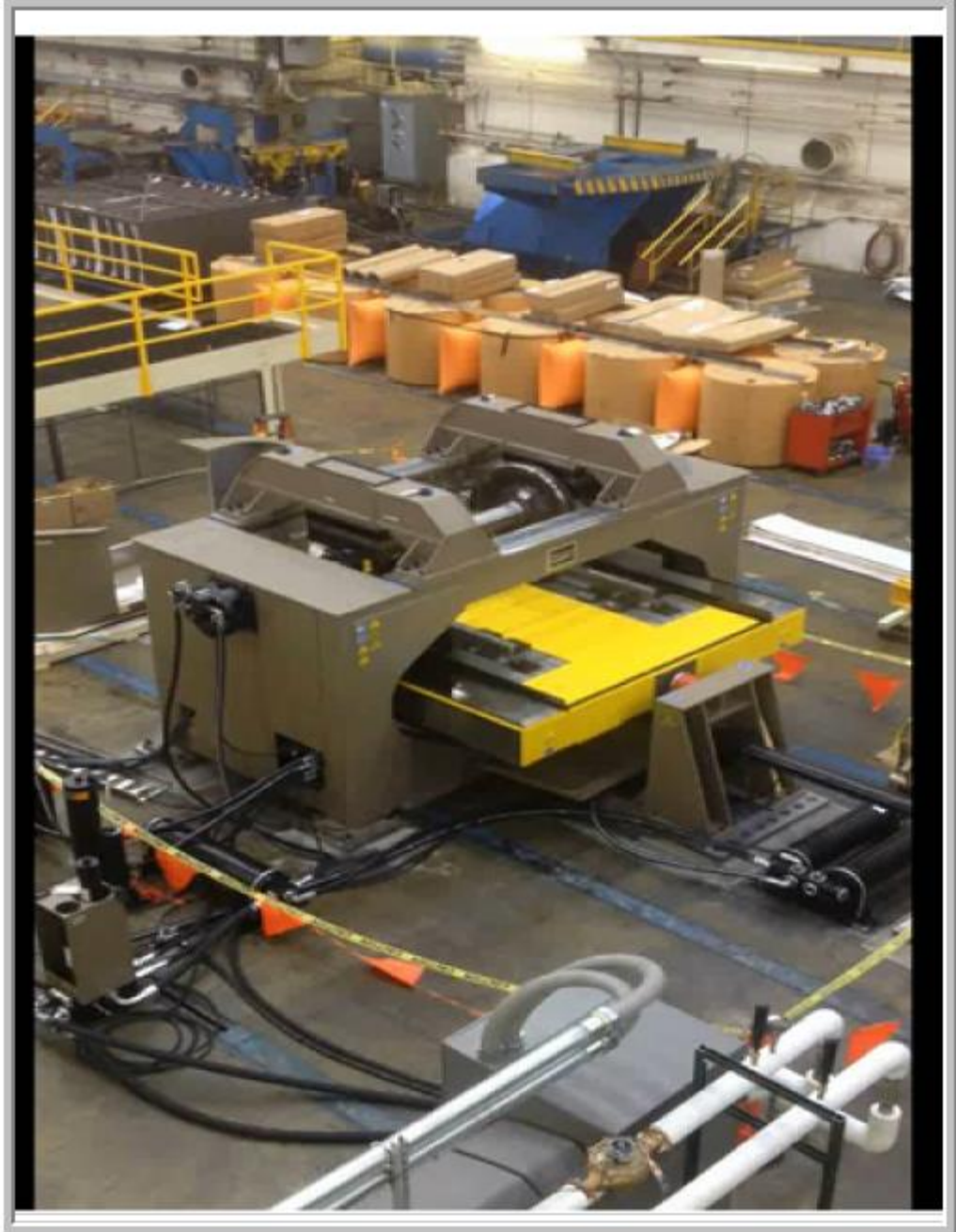
- ◆ **Ability to provide a spectrum of loads / angle to simulate mixed traffic / curving**
 - Better understanding the root causes of RCF
 - Predict RCF under service loads for different rail and wheel materials
 - Understand mechanism for crack initiation and propagation
 - Transition from horizontal growth to downward growth
 - Develop vehicle and track design and maintenance strategies
 - Optimize rail grinding frequencies





RCF Simulator Demonstration







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Benefits of Improved Truck Design

Mechanical Research



Mechanical Repair Spending Car Repair Billing Data Exchange

◆ Car Repair Billing (CRB) Data Exchange

- Represents a portion of industry running repairs
 - ▲ Over \$1.2 billion reported in 2013

- **Wheelsets (wheels, axles, and bearings)**

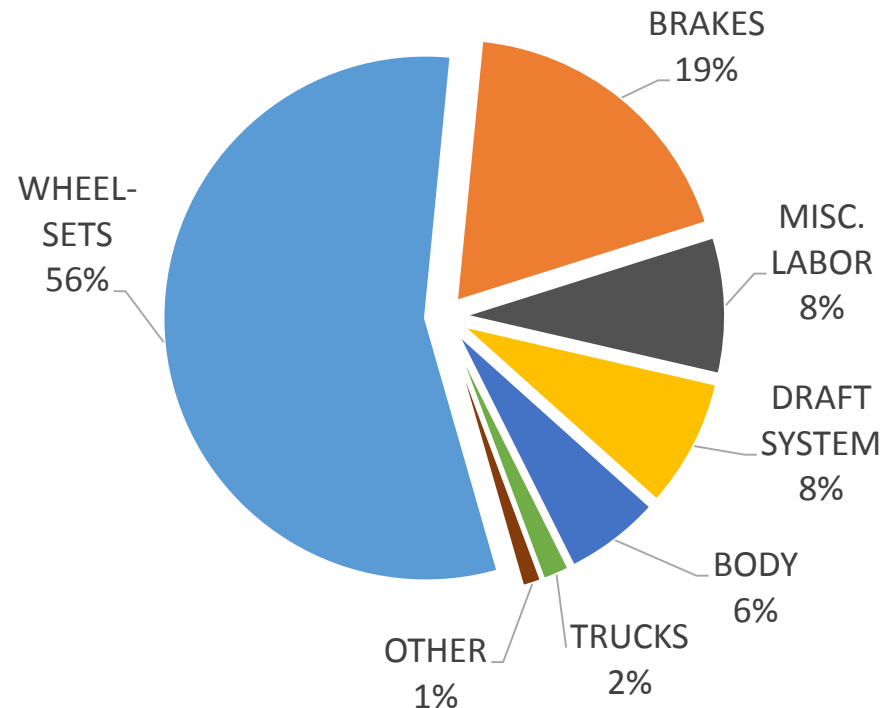
- ▲ Wheelset removals are driven primarily by tread damaged wheels

- **Brakes**

- ▲ Brake shoes, air brake testing, and valves comprise nearly 70 percent of brake-related cost respectively

- **Body**

- ▲ Securement 1* parts represent over 50 percent of body-related cost



CRB Spending by Category

Source: CRB Data Exchange, 2013

* Rule 74 SECURMENT. (...high tensile rivets/rivets, high tensile bolts / bolts, cotter, and split key...)





Factors Influencing Wheel Life

◆ Tread Scuffing

Result:

- Surface damage
- High impact wheels (HIW)

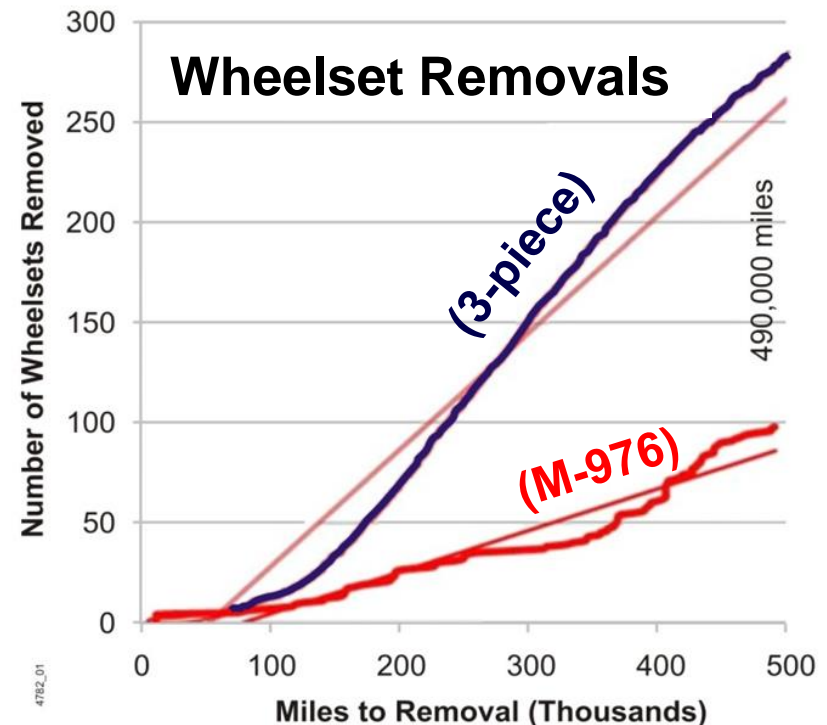
◆ Also: Continuous Spalling

- Associated with light car conditions

◆ Measured reduction in HIW removal in western coal service using M-976 trucks

- 3x reduction in the rate of initial removals
- Projected net 18% improvement in wheel life

◆ Objective: Further reduce HIW removals

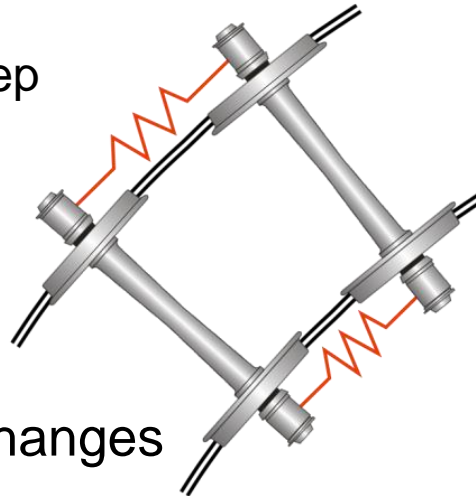




Review Truck Design Approach

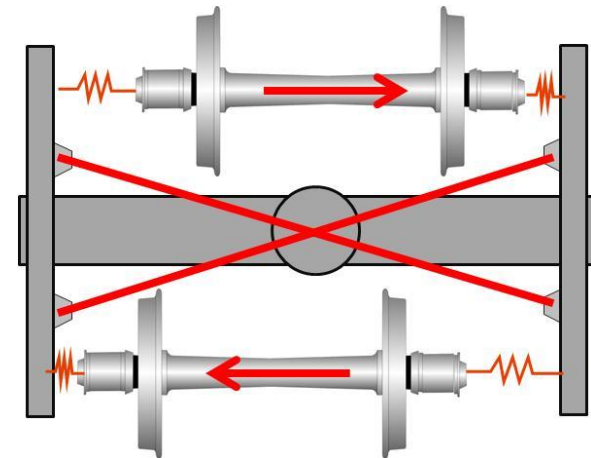
◆ Truck steering to improve wheel life

- Longitudinal resilience between axle and side frame allows a reduction in:
 - ▲ Angle of attack in curve
 - ▲ Low (& high) rail lateral creep force
- NOT a radial truck but a compromise design providing a “sweet spot” for 286k operation
- May require adapter pad changes



◆ Improved warp stiffness to retain hunting stability

- Frame brace or spring plank
- Improved wedge design?



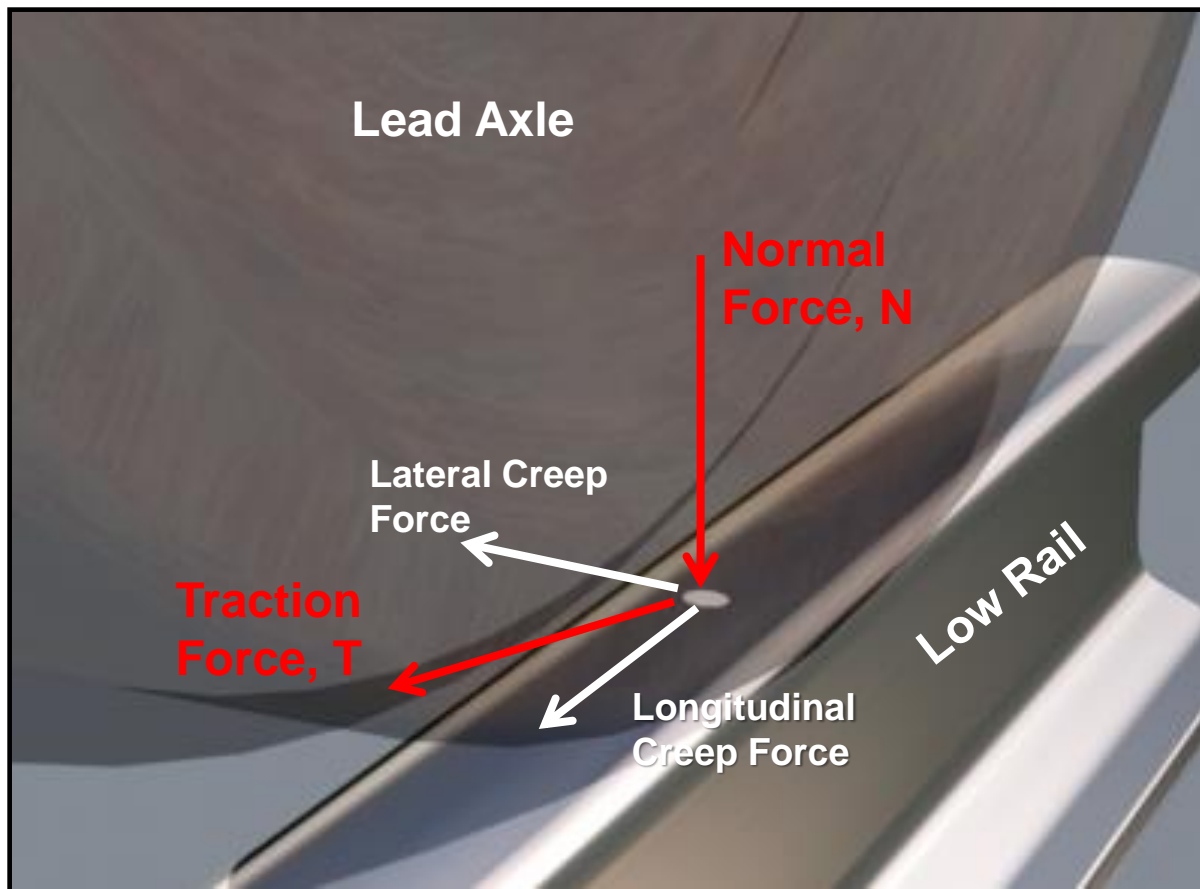
◆ Review: Traction Ratio (T/N)

- On lead axle
- In low rail contact
- Metric:

Traction Ratio
 T / N where:

- ▲ N = Normal force on the contact patch
- ▲ T = Vector sum of longitudinal and lateral creep forces

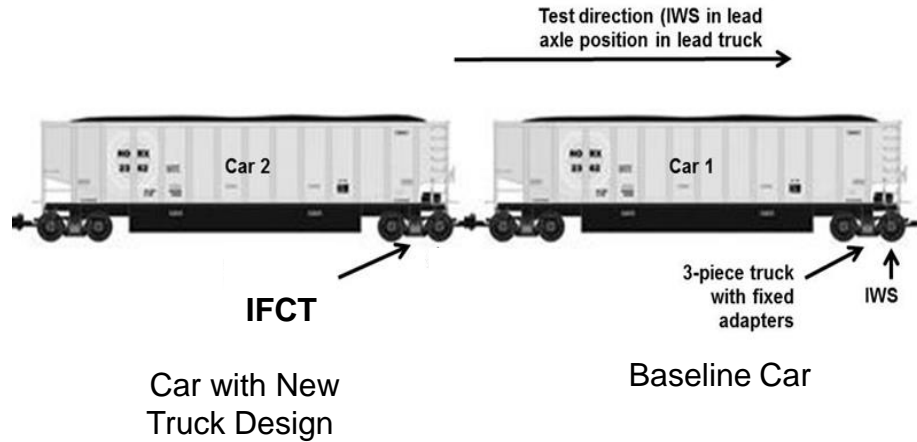
- Measurement:
 - ▲ Instrumented wheelset (IWS)





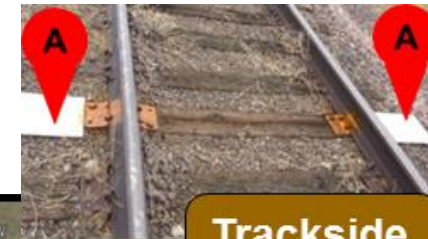
Review Curving Test Procedure

◆ Test consist:



◆ Measurement:

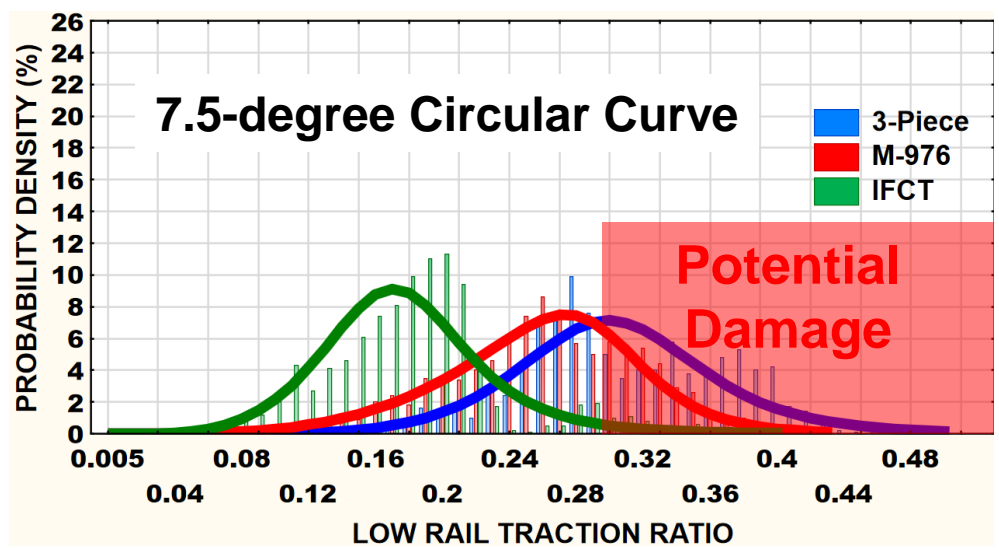
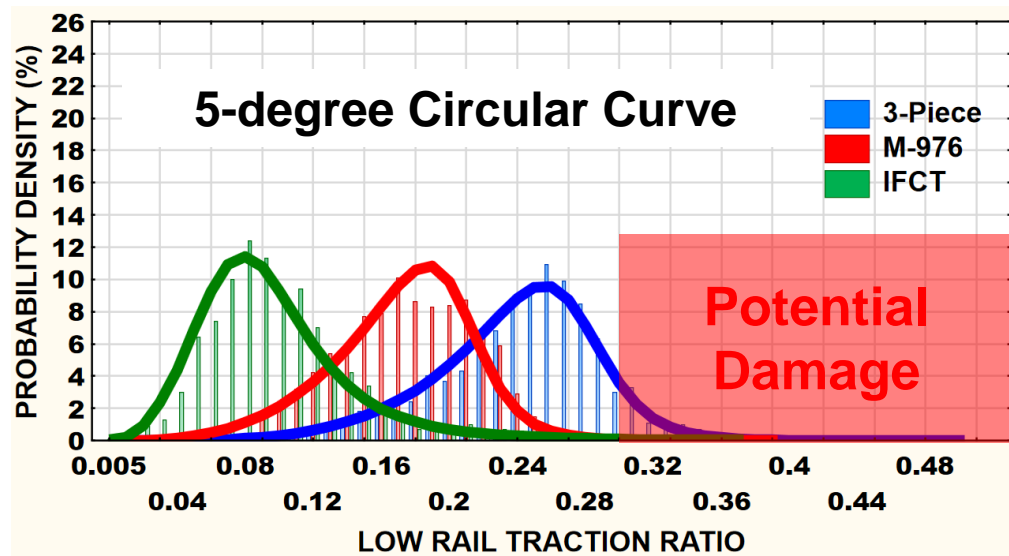
- Low rail T/N
- At balance speed
- Over 500 feet
- In circular curve



TTCI Curving Results

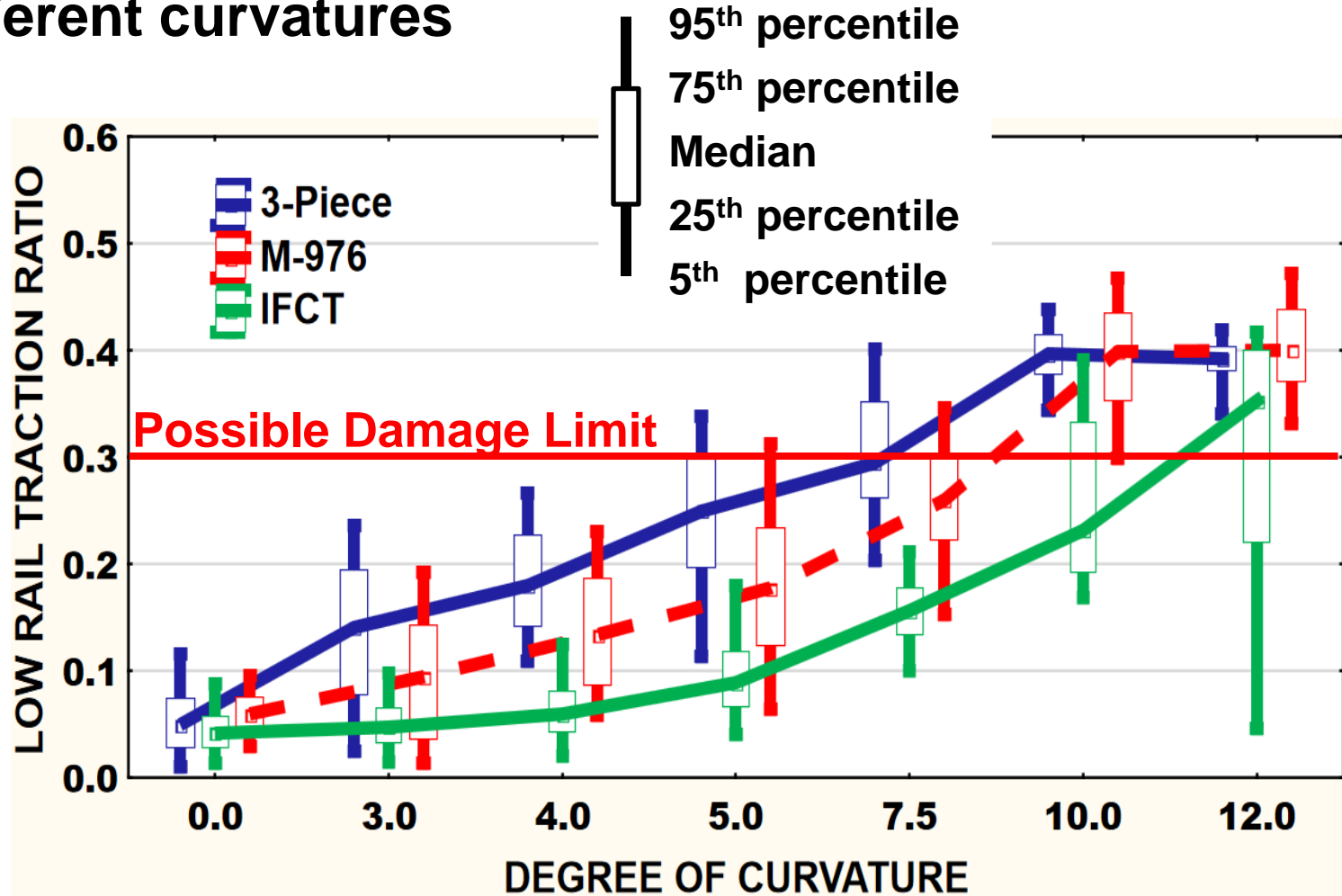
◆ T/N distributions for typical:

- 3-Piece
- M-976
- Typical IFCT



TTCI Curving Results

- ◆ Comparison of 3-piece and M-976 trucks with IFCTs for different curvatures





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Hazardous Materials Emergency Response Training

Training - Security and Emergency Response Training Center (SERTC)

- ◆ In operation at TTC since 1985
- ◆ Hazmat response for Surface Transportation
 - Focus on Rail and Highway
- ◆ Approximately 60,000 students trained
 - Railroad
 - Chemical and petroleum
 - Local, State and Tribal First Responders
- ◆ “Graduate level” program
- ◆ Emphasis on preparedness and response
- ◆ See www.sertc.org for more information



◆ **Classes use a “4-Phase Approach” that include at least 50% hands-on work**

- Theory, best practice, classroom lecture
- Cut-away training aids and hands-on work
- Techniques yard – field transfers and containment
- Response exercises using full-scale staged incidents



SERTC Facility at TTCI

- ◆ **Mixed freight derailment**
 - 43 cars and one locomotive
- ◆ **Highway equipment**
 - Diesel, gas, propane, anhydrous ammonia, mixed hazmat freight
- ◆ **Numerous rail and highway valves, fittings and cutaways in Highbay**
- ◆ **“Domehenge” uses pressurized air, water and smoke to simulate leaks**



Historic SERTC Course Offerings

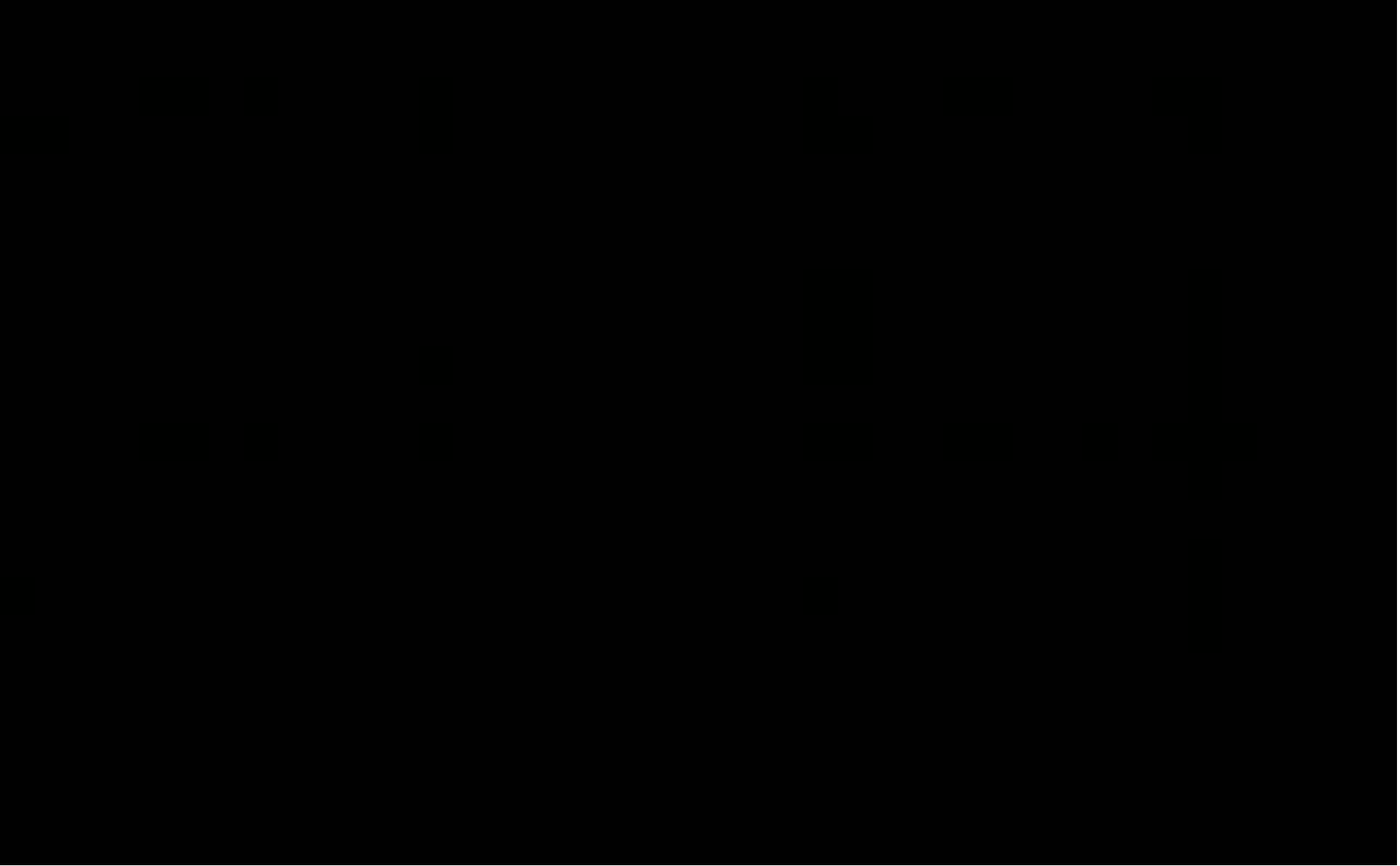
- ◆ Tank Car
- ◆ Highway
- ◆ Intermodal
- ◆ Hazmat/WMD Technician
- ◆ Tactical Hazmat Operations
- ◆ Leadership and Management



New Offering - Crude by Rail Training

- ◆ **19 Car Derailment**
 - 3D fire, impingement and pool fires
- ◆ **Boil over Car**
 - Demonstrates characteristics of crude
- ◆ **Teaches appropriate decision making for crude oil fires**





Ways to Sign Up for On-Site Training



◆ **Classes sponsored by DHS/FEMA**

- Register your interest at www.sertc.org
- Need approval from State Authorizing Agent
 - ▲ SAA will provide an authorization number
 - ▲ You will be allowed to register with an authorization number

◆ **Classes sponsored by Railroads**

- Register your interest at www.sertc.org
- Contact your Railroad Hazardous Materials Officer for more information on sponsorship

◆ **Open enrollment classes**

- Sign up at www.sertc.org



Questions?

