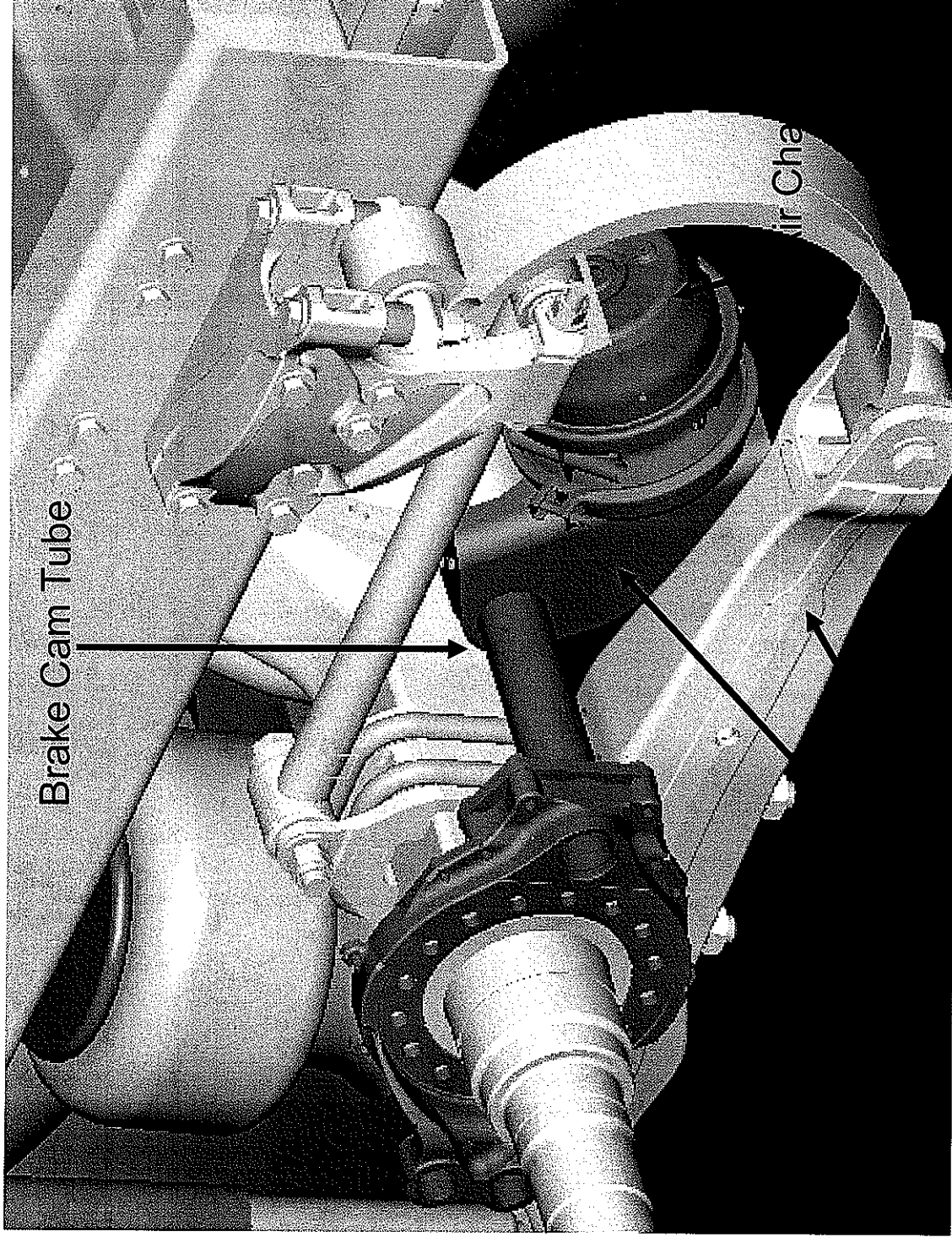


# Brake Assembly Update

February 11, 2009

# Brake Installation



# **Kenworth Safety Committee Review And Notification to NHTSA**

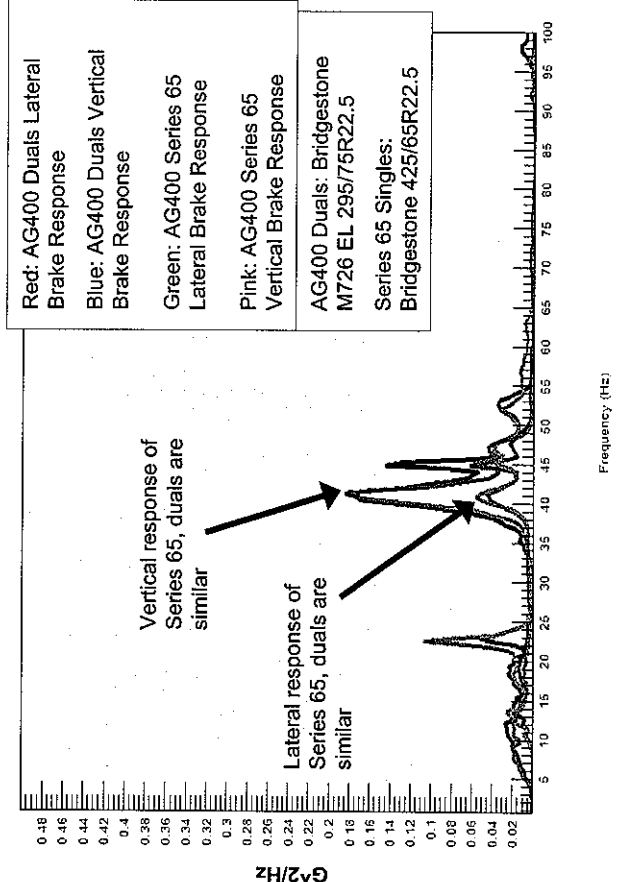
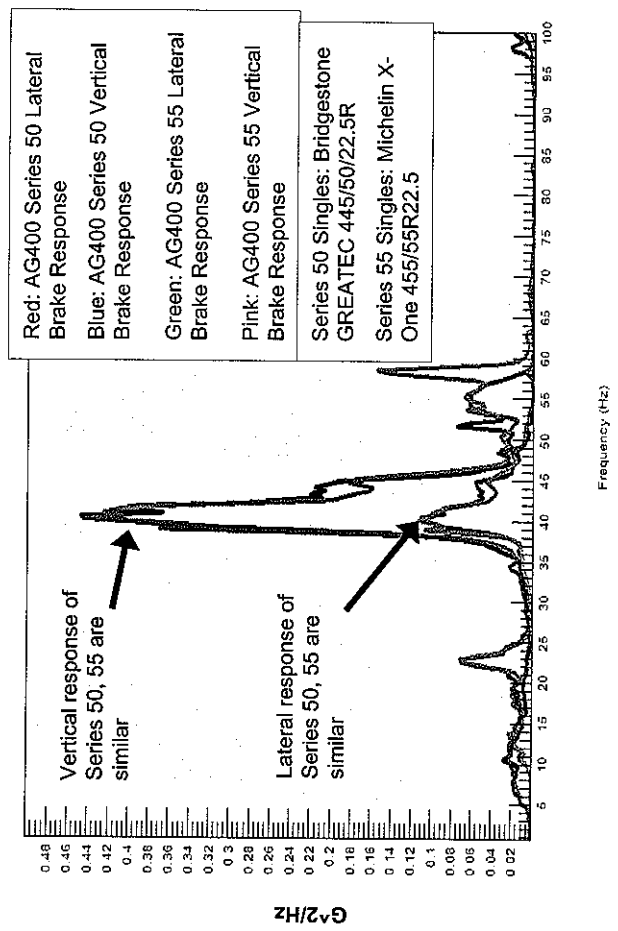
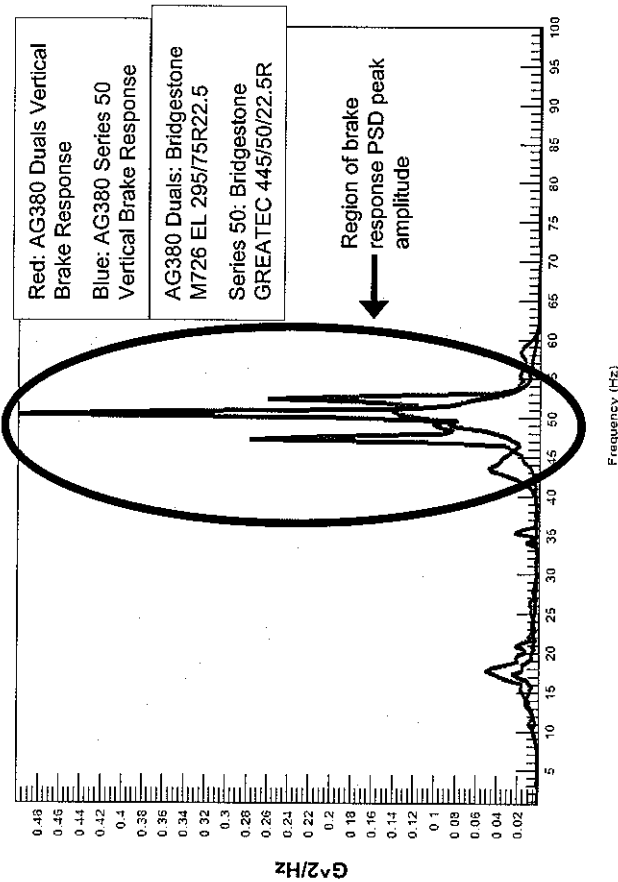
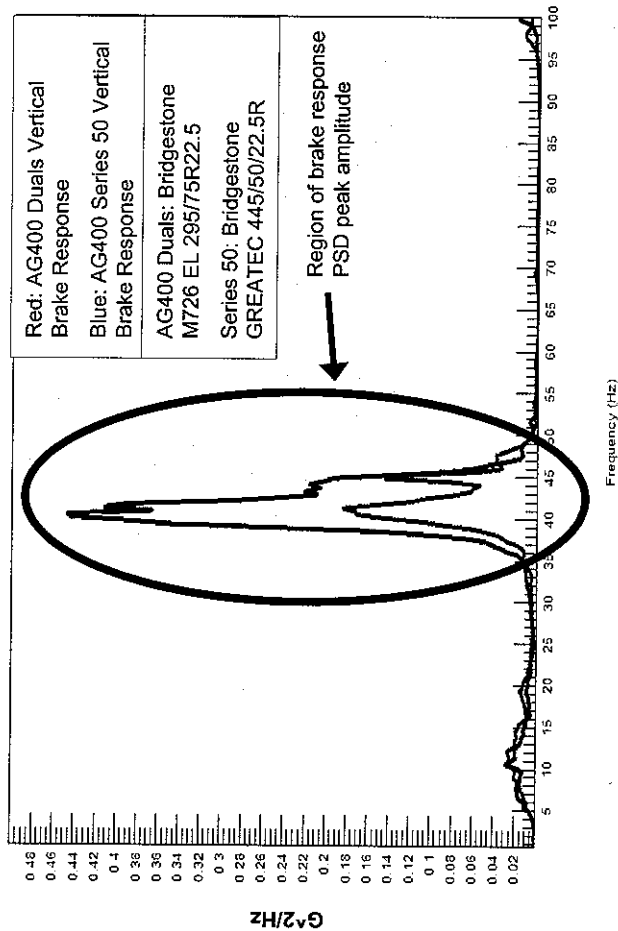
- **Early Review Of Cam Tube Length And Elevated Claim Rate Of Airglide (AG) 400 Suspension, Long Stroke Brake Chambers And Wide Base Single Tires Suggests Configuration Is A Contributor To Brake Assembly Cracking**
- **Based on information at the time Kenworth Safety Committee Determines A Potential Safety Defect May Exist For AG400 Rear Suspension With Long Stroke Brake Chambers And Wide Base Single Tires Which May Reduce Vehicle Braking Performance**
- **September 23, 2008, PACCAR (Kenworth) Submits 573 Defect And Noncompliance Report (Recall) To NHTSA For This Specific Configuration Stating That Affected Chassis And Proposed Solution Would Be Identified At A Later Date**

# PACCAR Technical Center (PTC)

## Testing Summary

- Series 50 And 55 Wide Base Tires Cause Increased Axle Frequency Content When Compared To Dual Tires At 40-50 Hz.
- Series 65 Wide Base Single Tires Are Similar In Behavior To Dual Tires.
- AG380, AG400, And Primaax Suspensions Provide Similar Axle Vibration Environments Across 40-50 Hz

# PTC Data Collection



# Low Profile Wide Base Single Tire Introduction

2002

2003

2004

▲ KW - Bridgestone GREATEC Wide Base Single 50 Series Tire Released, 12/01

▲ PB - Michelin XONE Wide Base Single 50/55 Series Tire Released, 4/02

▲ KW - Michelin XONE Wide Base Single 50/55 Series Tire Released, 8/02

PB - Bridgestone GREATEC Wide Base Single 50 Series Tire Released, 4/04 ▲

- Low Profile (50 And 55 Series) Wide Base Single Tires Are Used Exclusively On Drive Axles, As Opposed To 65 Series Wide Base Tires Which Have A History As Both Steer And Drive Tires

# Field Reports (NSR's)

All Wide Base Single, Series 50 Or 55 Tires

| Model                 | Model Yr | KW AG380 | KW AG400/460 | Totals by Model |
|-----------------------|----------|----------|--------------|-----------------|
| T2000                 | 2006     |          | 5            | 5               |
| T600                  | 2007     |          | 1            |                 |
| T600                  | 2008     | 3        |              | 4               |
| T800                  | 2005     |          | 25           |                 |
| T800                  | 2006     |          | 12           |                 |
| T800                  | 2007     | 3        | 11           | 51              |
| W900                  | 2007     |          | 1            | 1               |
| Totals by Suspension: |          | 6        | 55           | 61              |

**Kenworth**

| Model                | Model Yr | FLEXAIR | Totals by Model |
|----------------------|----------|---------|-----------------|
| 379                  | 2006     | 3       |                 |
| 379                  | 2007     | 3       | 6               |
| 387                  | 2007     | 1       | 1               |
| Total by Suspension: |          | 7       | 7               |

**Peterbilt**

# Warranty Claims

All Wide Base Single, Series 50 Or 55 Tires

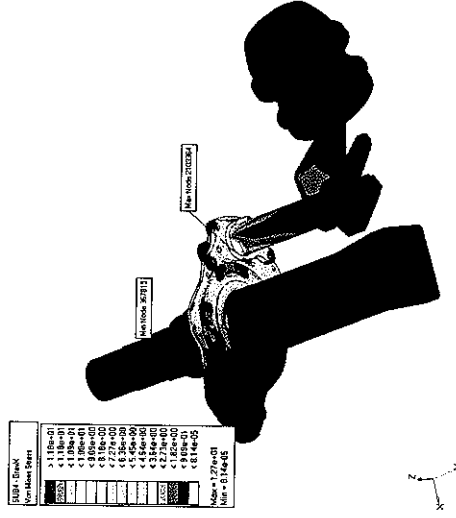
| Base Model           | ModelYr | KW AG400/460 | KW AG380 | CHALMERS 854 | KW AG200 | HEND PRIMAX | Total By Model |
|----------------------|---------|--------------|----------|--------------|----------|-------------|----------------|
| T2000                | 2005    | 1            |          |              |          |             | 1              |
| T2000                | 2006    | 15           |          |              |          |             | 15             |
| T2000                | 2007    | 1            | 9        |              |          |             | 10             |
| T2000                | 2008    |              | 6        |              |          |             | 6              |
| T600                 | 2003    |              |          |              | 3        |             | 3              |
| T600                 | 2004    | 26           |          |              |          |             | 26             |
| T600                 | 2005    | 62           |          |              |          |             | 62             |
| T600                 | 2006    | 29           | 2        |              |          |             | 31             |
| T600                 | 2007    | 62           | 31       |              |          |             | 93             |
| T600                 | 2008    | 1            | 2        |              |          |             | 3              |
| T600                 | 2009    | 1            |          |              |          |             | 1              |
| T800                 | 2005    | 12           | 2        |              |          |             | 14             |
| T800                 | 2006    | 61           | 4        |              |          |             | 65             |
| T800                 | 2007    | 48           | 15       | 2            |          |             | 65             |
| T800                 | 2008    | 20           |          |              |          |             | 20             |
| T800                 | 2009    | 13           |          |              |          |             | 13             |
| W900                 | 2003    |              |          |              | 1        |             | 1              |
| W900                 | 2006    | 11           |          | 17           |          |             | 28             |
| W900                 | 2007    | 30           | 1        |              |          | 1           | 32             |
| W900                 | 2008    | 2            |          |              |          |             | 2              |
| W900                 | 2009    | 6            |          |              |          |             | 6              |
| Total By Suspension: |         | 401          | 72       | 19           | 4        | 1           | 497            |

**Kenworth**

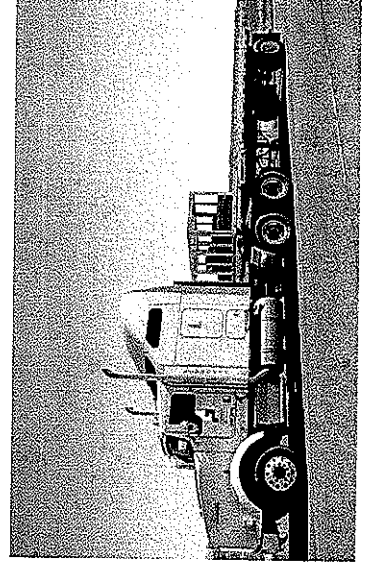
| Base Model           | ModelYr | FLEX AIR 38,000 LBS | LOW AIRLEAF /TR 38,000 LBS | LOW AIR LEAF 40,000 LBS | AIRLEAF /TR 38,000 LBS | AIR TRAC 40/44/46,000 LBS | Total by Model |
|----------------------|---------|---------------------|----------------------------|-------------------------|------------------------|---------------------------|----------------|
| 379                  | 2003    | 1                   | 1                          |                         |                        |                           | 85             |
| 379                  | 2004    | 3                   |                            |                         |                        |                           |                |
| 379                  | 2005    | 0                   |                            | 1                       |                        |                           |                |
| 379                  | 2006    | 43                  |                            | 1                       |                        |                           |                |
| 379                  | 2007    | 33                  |                            | 2                       |                        |                           |                |
| 387                  | 2003    | 2                   |                            |                         |                        |                           | 24             |
| 387                  | 2004    | 1                   |                            |                         |                        |                           |                |
| 387                  | 2005    | 0                   |                            |                         |                        |                           |                |
| 387                  | 2006    | 13                  |                            |                         |                        |                           |                |
| 387                  | 2007    | 8                   |                            |                         |                        |                           |                |
| 386                  | 2007    | 3                   |                            | 1                       | 1                      | 1                         | 6              |
| 378                  | 2005    | 1                   |                            |                         |                        |                           | 1              |
| 357                  | 2006    | 1                   |                            |                         |                        |                           | 1              |
| Total by Suspension: |         | 109                 | 1                          | 5                       | 1                      | 1                         | 117            |

**Peterbilt**

- TUV SUD America Inc
- TUV Recommended By Bendix
- Brake Assembly Vibration Test Set Up Shown



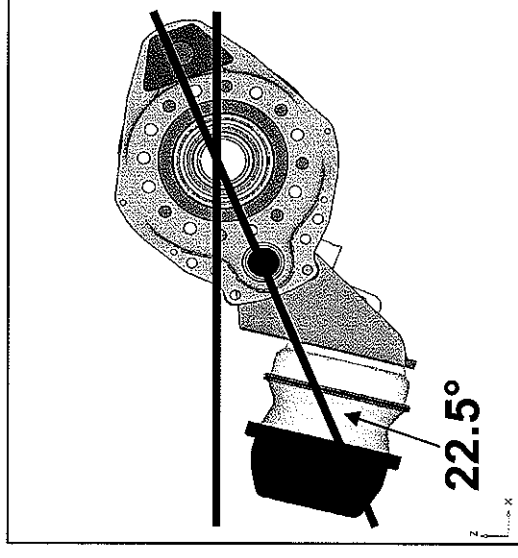
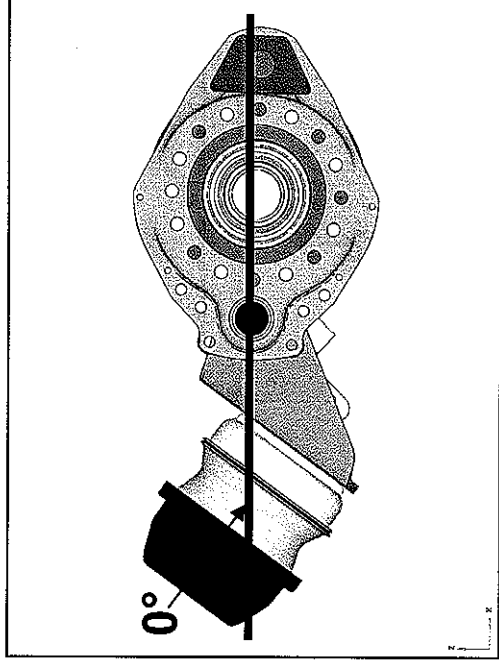
- PACCAR Technical Center & Kenworth
- FEA Of Cam Tube Base Shown



- Link West
- Widely Used Within Industry For FMVSS Testing
- Test Vehicle And Mesa AZ Location Shown

# Brake Assembly Clock Angle Comparison

- Brake Clock Angle Is Driven By The Suspension Space Claim
- FEA - Vibration Modes Unchanged With No Change To The Resonant Frequencies
- FEA - Cam Tube Stress Increase In The Vertical Direction By 24% At 22.5 ° Compared To 0°

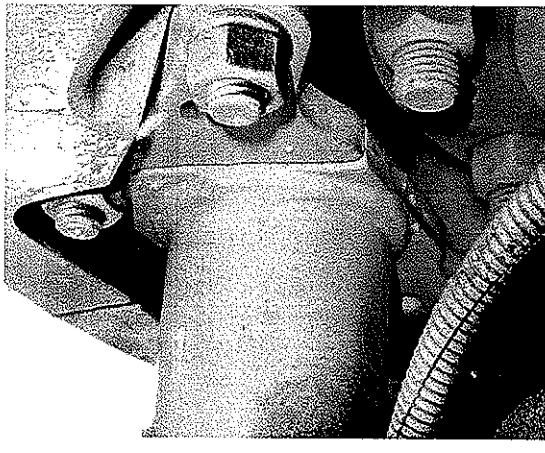


# Crack Detection Rate

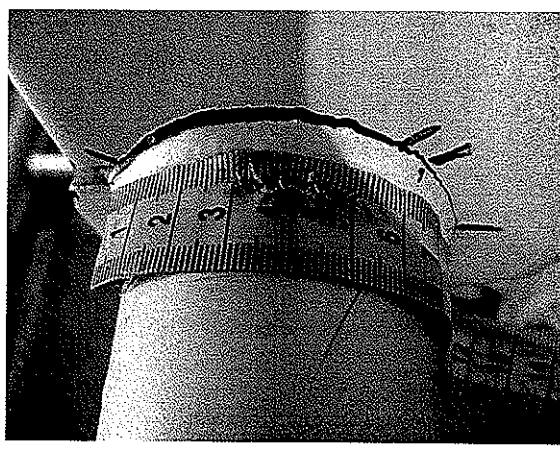
- AG400/460 Susp (22.5 Deg Clock Angle) And Bendix Brakes:
  - B5 Life Of 350,000 Miles
  - 172 Cracked Parts Out Of 3,449 Vehicles At 350K Miles
- AG380 Susp (0 Deg Clock Angle) And Bendix Brakes:
  - B5 Life Of 550,000 Miles
  - 137 Cracked Parts Out Of 2,742 Vehicles At 550K Miles
- AG400/460 Susp (0 Deg Clock Angle) And Stamped Meritor Brakes:
  - B5 Life Of 2,500,000 Miles
  - 7 Cracked Parts Out Of 149 Vehicles At 2.5 Million Miles
- AG400/460 Susp (0 Deg Clock Angle) And Cast Meritor Brakes:
  - B5 Life Of 1,200,000 Miles
  - 4 Cracked Parts Out Of 83 Vehicles At 1.2 Million Miles

# Crack Propagation Testing

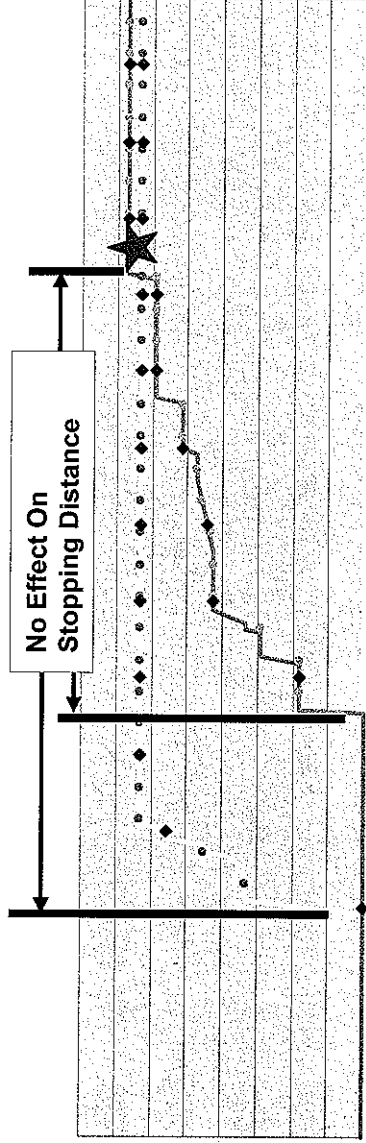
- Stopping Distance
  - 6X4 tractor loaded and brakes burnished per FMVSS 121
  - Cam tube flanges and chamber bracket ground in 0.8" increments
  - 60 MPH emergency brake stops for every 0.8" increment
  - Continued until flanges/bracket cracked through
  - No Effect On Stopping Distance until full separation



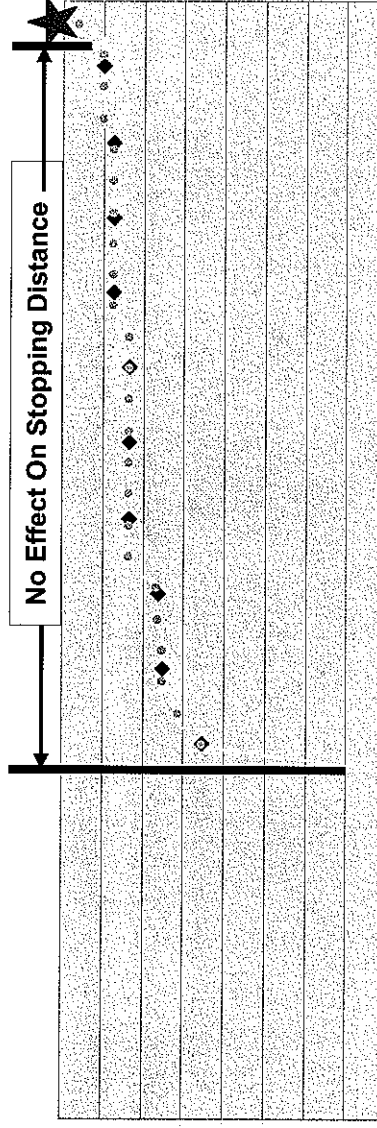
- Shake Test
  - Cam tube flange and chamber bracket inspected for cracking every 2 minutes
  - Crack length recorded
  - Shake test continued until flanges/bracket cracked through



# Crack Propagation vs. Mileage



**Qty 18, 50K  
Services Before  
Stopping Distance  
Affected**



**Qty 9, 120K  
Inspections Before  
Stopping Distance  
Affected**

**Truck Mileage**

Cam Tube Upper Flange    Chamber Bracket    120K Annual Service    50K Service Interval  
Cam Tube Lower Flange    ☆ Stopping Distance And Parking Brake Capability Affected

# Cam Tube Upper Flange Crack Propagation

1.4" Crack @ 351K Miles



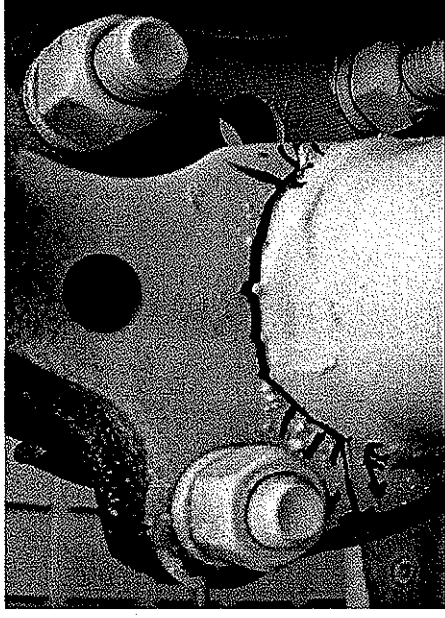
1.7" Crack @ 420K Miles



2.4" Crack @ 450K Miles



3.1" Crack @ 489K Miles



No Effect On Stopping Distance

# Cam Tube Lower Flange Crack Propagation

0.9" Crack @ 670K Miles



1.0" Crack @ 748K Miles



2.1" Crack @ 816K Miles

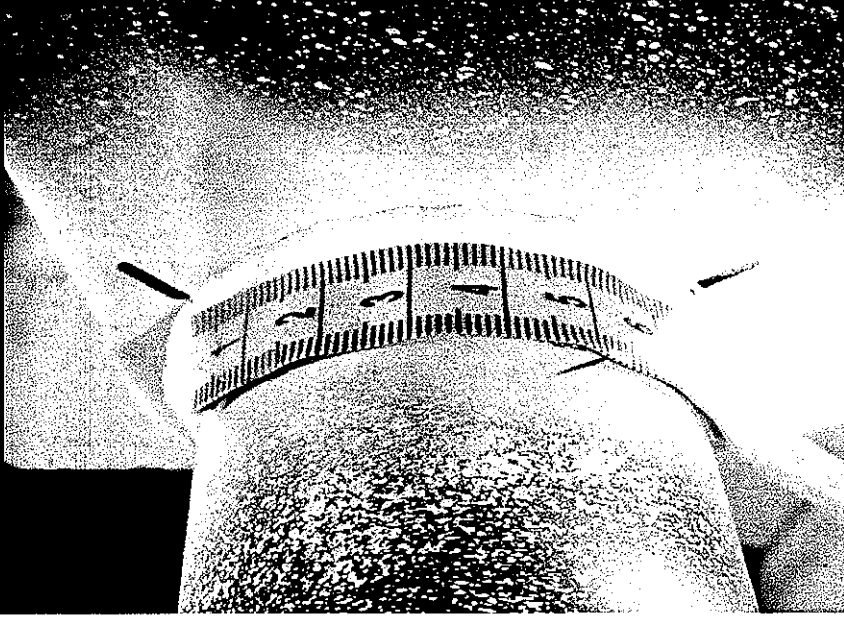


3.4" Crack @ 1,784K Miles Qty

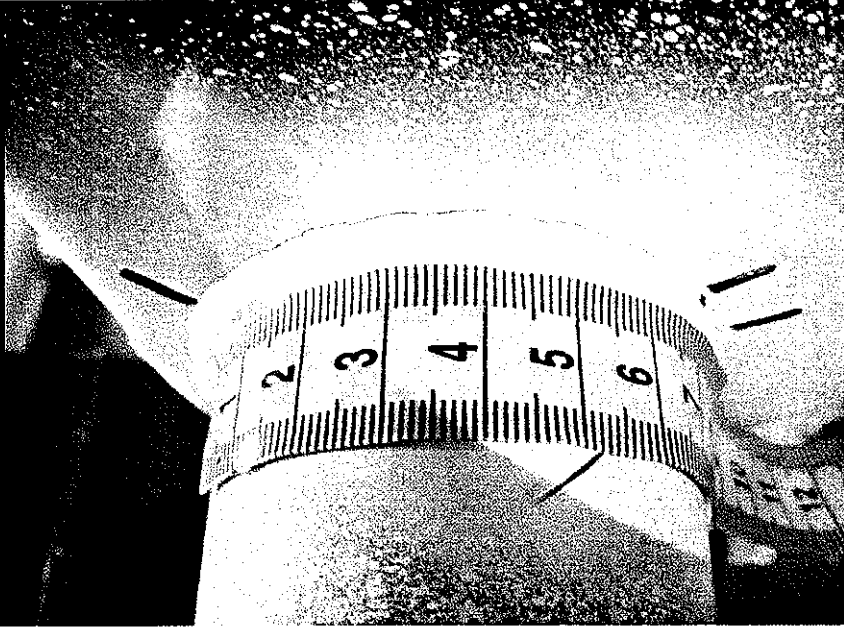
No Effect On Stopping Distance

# Brake Chamber Bracket Crack Propagation

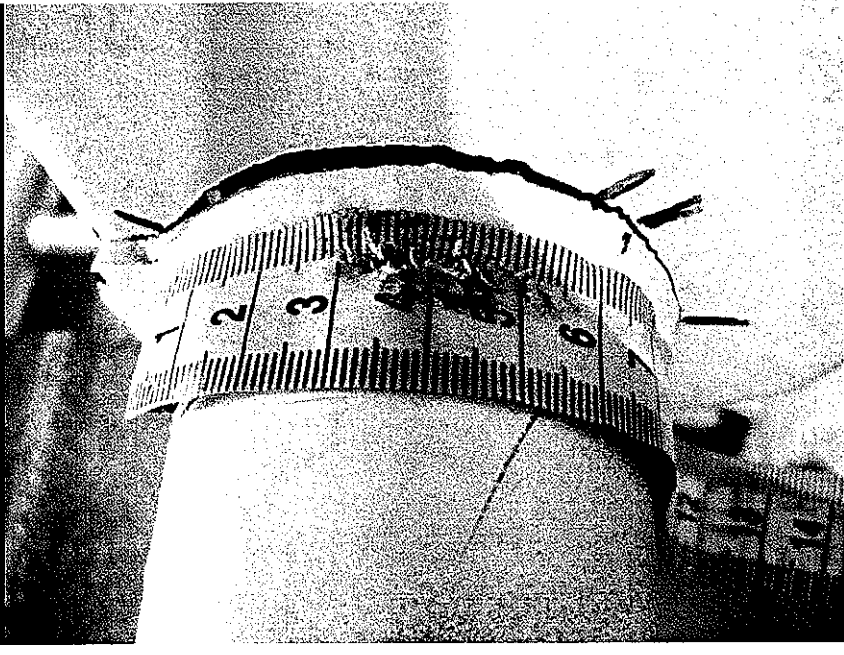
2.8" Crack @ 625K Miles



3.5" Crack @ 1,583K Miles



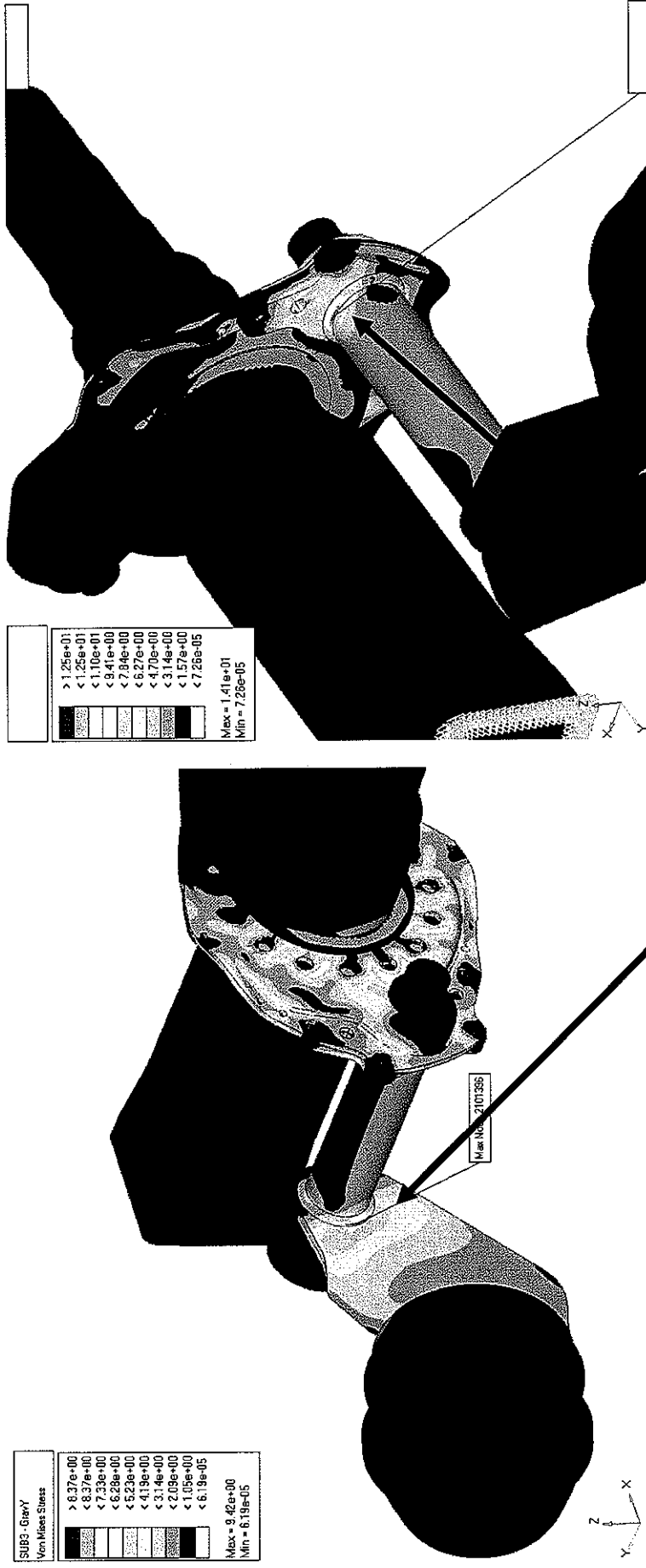
4.0" Crack @ 1,784K Miles



No Effect On Stopping Distance

Stopping Distance  
Affected

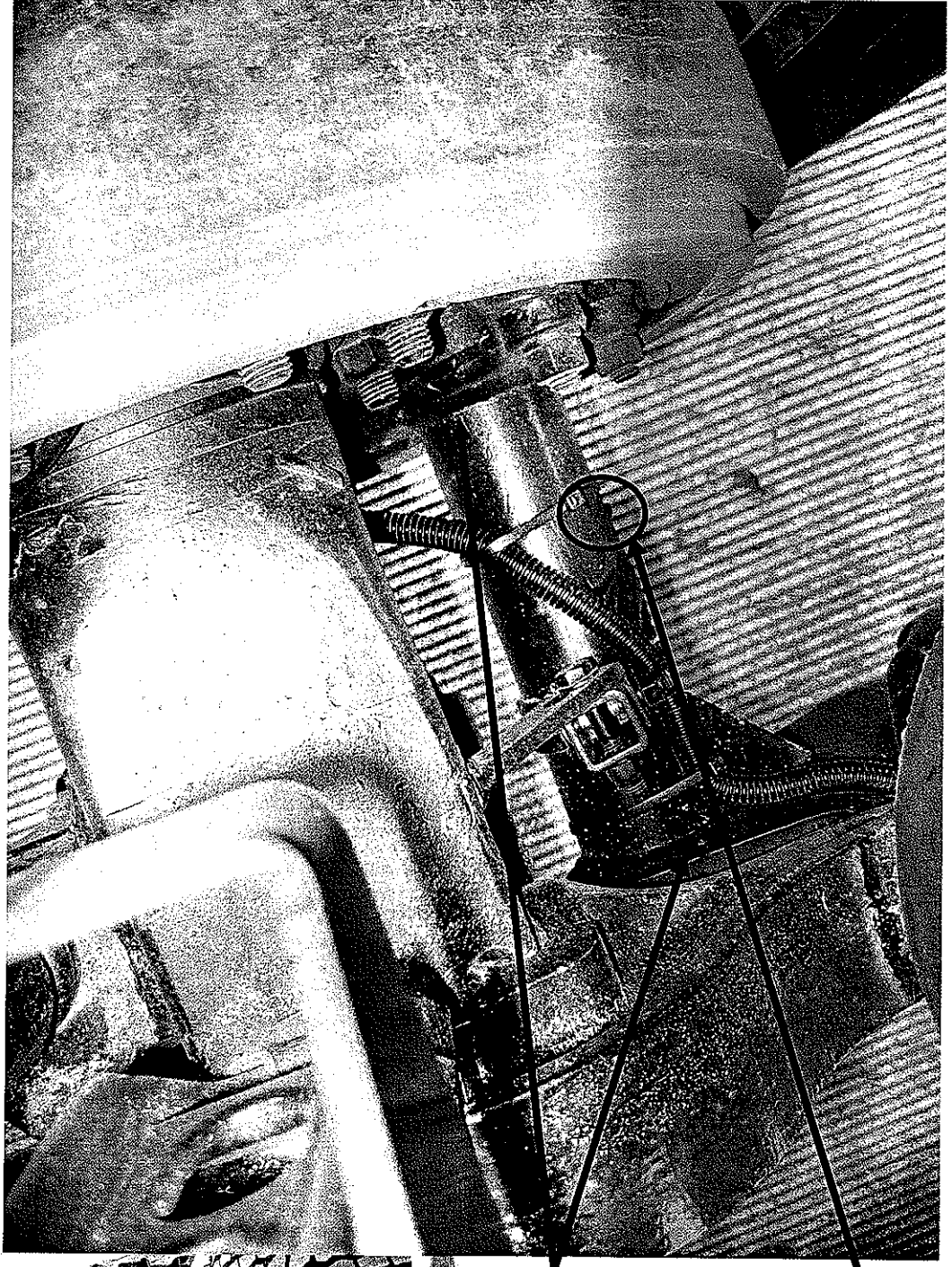
# Brake Assembly Inspection



Areas Of Inspection

# Brake Assembly Inspection

## Top View



Areas Of Inspection

Lube Point Fitting

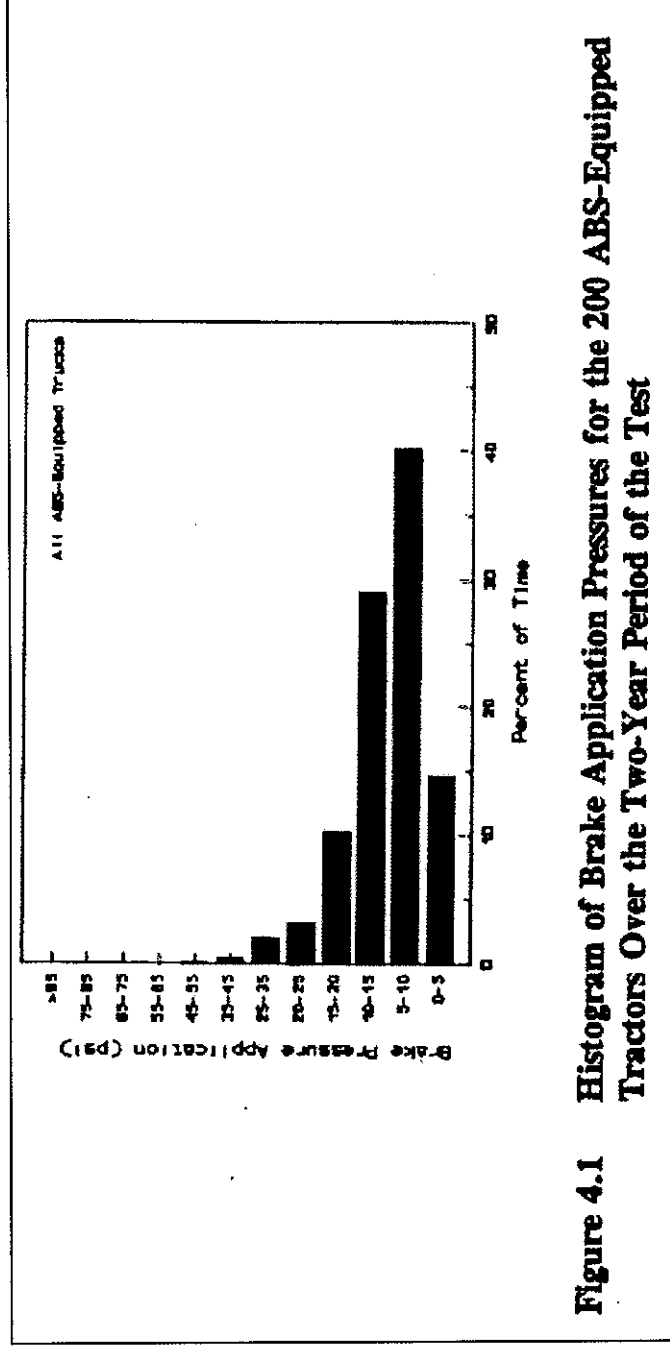
# Inspection – Customer Feedback, Kenworth

- Fleets:
  - Conway, Central Refrigerated Services (CRS), New Century
- Fleet Questions:
  - How Is Brake Assembly Cracking Detected?
- Fleet Response:
  - Conway, CRS, New Century Cracked Cam Tubes Were Found During Routine Maintenance And Walk Around Inspections
- No Reduced Braking Function Was Reported

# Inspection – Customer Feedback, Peterbilt

- Fleets:
  - TMC, 1<sup>st</sup> Class, Pilot Oil, Long Trucking, Northern Refrigeration
- Fleet Questions:
  - How Is Brake Assembly Cracking Detected?
- Fleet Response:
  - TMC & 1<sup>st</sup> Class, Cracked Cam Tubes Were Found During Routine Maintenance And Walk Around Inspections
    - No Reduced Braking Function Was Reported
  - Pilot Oil Was Made Aware By The Bendix Field Notification, They Have Experienced No Cracking
  - Long Trucking Added Reinforcements When They Refitted The Unit With Wide Base Single Tires, No Cracking
  - Northern Refrigeration, Field Service Met With The Fleet Manager To Review Cracked Brackets Found During Maintenance

# Vehicle Brake Application



- 1992 NHTSA Study
  - 13 Million Brake Applications Over 600,000 Miles
  - Only 0.02% Of Total Braking Time Was At 75 PSI Or Greater
  - Brake System Redundancy Provided With Application Pressures < 75 PSI
  - **Stopping Distance Unaffected With One Sixth Of The Brakes Inoperable**

# Out of Service Criteria

- Commercial Vehicle Safety Alliance (CVSA) Roadside Inspection Criteria States, "**A vehicle or combination vehicle is out of service if 20% or more of its brakes** have one of the following defects . . . (cracked) loose air chamber, spider, or camshaft support bracket".
- This In Effect Allows A 5 Axle Combination Vehicle To Continue IN SERVICE With One Loose (Broken) Air Chamber Mounting Bracket, Or Other Major Mechanical Problem Rendering **One Brake Inoperative. A Broken Air Chamber Bracket Is No Worse Than A Non-adjusting Auto Slack**, Oil Soaked Linings, Or Lining Pads Worn Too Thin.

# Discussion

- No Effect On Stopping Distance; Therefore A Safety Related Defect Does Not Exist
- Inspection Campaign And Extended Warranty