NHTSA

Vehicle Research and Test Center

INFORMATION REDACTED PURSUANT TOTHE FREEDOM OF INFORMATION ACT (FOIA), 5 U.S.C.552(B)(6)

# Review of VRTC Inspections and Tests of Haldex Spring-Brake Chambers as Mounted on DTNA Sterling Autohaulers

January 30, 2013

# VRTC Inspections and Tests of Haldex Spring-Brake Chambers

- Inspection and bench tests of chambers removed from service
- Disassembly, inspection, testing of debris
- Vehicle tests for unintended brake drag and parking brake operation
- Metallurgy of the power spring
- Comparison to peer spring-brake chamber
- Summary

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| Cassens Transport Information | | | | | | Initial Inspection | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Unit No. | VIN | Time in Service (days) | Failure Miles | Work Order No. | Rear Double-Axle Position | Type | Drop Test Sound | Exterior Inspection Comments | Actuator Pushrod Position | Bore-Scope Inspection |
| 76093 | 2FZHCMCVX6A[redacted] | 1,566 | 199,176 | 551098330 | na | 24/303 | spring vibration | when rotated sand fell out | slightly angled | corrosion |
| 78063 | 2FZHCMCV57A[redacted] | 871 | 200,070 | 551100601 | na | 24/303 | spring vibration | na | straight | corrosion |
| 78109A | 2FZHCMCV77A[redacted] | 812 | 145,180 | 551100967 | na | 24/303 | spring vibration | na | straight | corrosion |
| 78109B | 2FZHCMCV77A[redacted] | 812 | 145,180 | 551100967 | na | 24/303 | spring vibration | na | straight | corrosion |
| 78271 | 2FZHCMCV57AX[redacted] | 709 | 173,020 | 551120942 | LF | 24/303 | spring vibration | housing different model | na | corrosion |
| 76369 | 2FZHCMCV96A[redacted] | 1,495 | 267,928 | OUTSIDE VENDOR | na | 24/303 | spring vibration | na | na | broken spring |
| 77109 | 2FZHCMCV97A[redacted] | 1,034 | 238,640 | 551091791 | na | 24/303 | spring vibration | na | straight | corrosion |
| 78017 | 2FZHCMCV47A[redacted] | 1,037 | 240,910 | 551119562 | RR | 24/303 | dead | pushrod angled and not returning | angled | broken spring |
| 77071 | 2FZHCMCVX7[redacted] | 1,019 | 212,120 | 551083156 | LR | 24/303 | spring vibration | no tag, number on case | straight | corrosion |
| 78003 | 2FZHCMCV77A[redacted] | 998 | 225,800 | 551113915 | na | 24/303 | spring vibration | na | straight | corrosion |
| 76039 | 2FZHCMCV16[redacted] | 2,041 | 193,289 | 551161227 | LR | 24/303 | dead | when rotated sand fell out, pushrod angle | angled | broken spring, torn diaphragm |
| 78023 | 2FZHCMCVX7A[redacted] | 1,309 | 314,200 | 601150387 | na | 30/303 | dead | housing different size | slightly angled | broken spring, torn diaphragm |

| Cassens | Initial Inspection | | | | | Pushro | Leak-Down Time/Pressure Test | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Shop Air Supply, Turn Off, | | | | | |
| Unit No. | Type | Drop Test Sound | Exterior Inspection Comments | Actuator Pushrod Position | Bore-Scope Inspection | Push-rod Stroke (in) | With Shop Air | After 30 sec | After 60 sec | After 90 sec | After 120 sec | Detected Leak |
| 76093 | 24/303 | spring vibration | when rotated sand fell out | slightly angled | corrosion | 3.06 | 100 | 100 | 100 | 100 | 100 | no |
| 78063 | 24/303 | spring vibration | na | straight | corrosion | 2.93 | 100 | 100 | 100 | 100 | 100 | no |
| 78109A | 24/303 | spring vibration | na | straight | corrosion | 2.97 | 100 | 100 | 100 | 100 | 100 | no |
| 78109B | 24/303 | spring vibration | na | straight | corrosion | 3.06 | 100 | 100 | 100 | 100 | 100 | no |
| 78271 | 24/303 | spring vibration | housing different model | na | corrosion | 3.00 | 100 | 100 | 100 | 100 | 100 | no |
| 76369 | 24/303 | spring vibration | na | na | broken spring | 2.56 | 100 | 100 | 100 | 98 | 98 | yes, just on application of shop air |
| 77109 | 24/303 | spring vibration | na | straight | corrosion | 3.06 | 100 | 96 | 92 | 88 | 83 | yes, just on application of shop air |
| 78017 | 24/303 | dead | pushrod angled and not returning | angled | broken spring | 2.62 *A 2.06 *B | 100 | 95 | 95 | 95 | 95 | sometimes at pushrod sleeve |
| 77071 | 24/303 | spring vibration | no tag, number on case | straight | corrosion | 3.06 | 100 | 93 | 85 | 73 | 69 | no leak heard |
| 78003 | 24/303 | spring vibration | na | straight | corrosion | 3.06 | 100 | 87 | 75 | 70 | 36 | yes, pushrod sleeve |
| 76039 | 24/303 | dead | when rotated sand fell out, pushrod angle | angled | broken spring, torn diaphragm | 2.00 | 98 | 0 | 0 | 0 | 0 | yes, diaphragm ruptured |
| 78023 | 30/303 | dead | housing different size | slightly angled | broken spring, torn diaphragm | 0.63 | 46 | 0 | 0 | 0 | 0 | yes, diaphragm ruptured |

78003



78109B



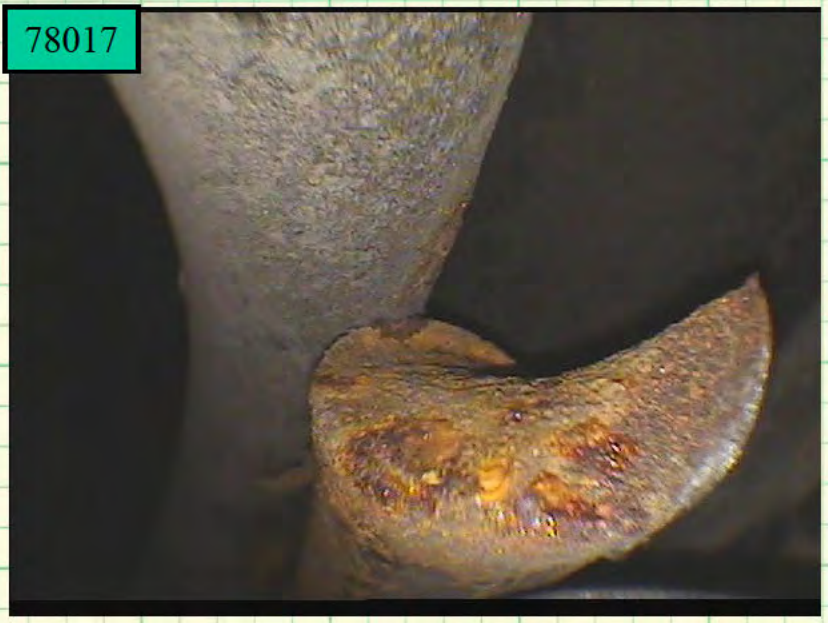
78017



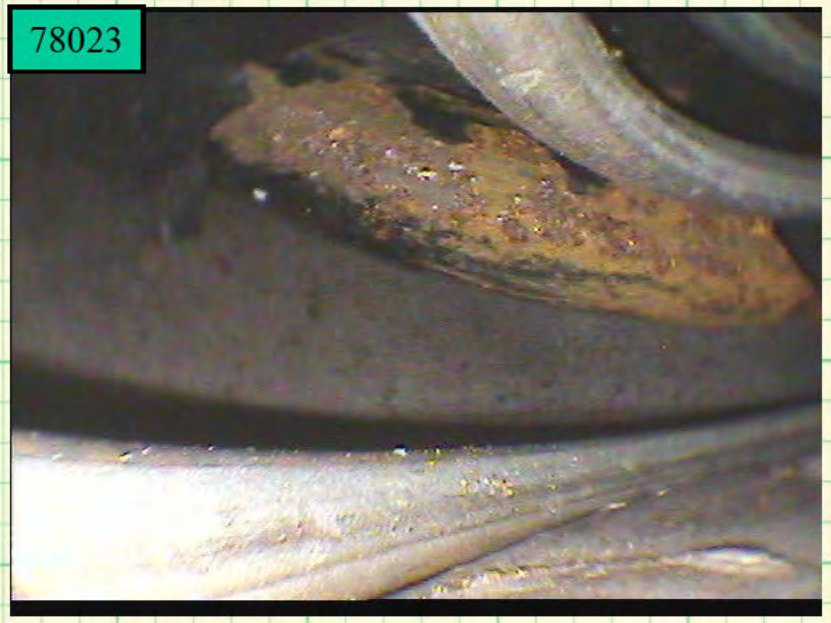
78109A



78017



78023



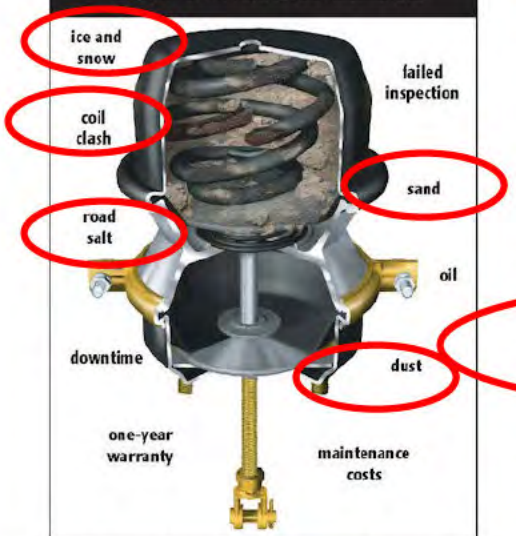
78023



78023



# THE PROBLEM




**Standard Competitor's Spring Brake**

## Ordinary spring brakes wear out too soon usually from corrosion and contamination.

Ordinary spring brakes have vent holes, some even have external breather tubes, many have missing caging tool plugs.

These ordinary spring brakes will usually perform adequately for one to three years in regular service (even less in vocational applications) but problems from water, dirt and road salt will lead to premature breakage of the power spring.

Broken power springs lead to unscheduled repair and replacement, costly downtime, roadside repairs and even unsafe or inadequate braking performance.





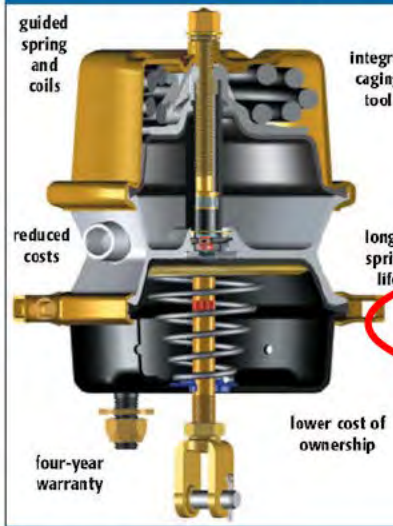
## Severe corrosion testing with exposure to salt/mud slurry.

**ORDINARY SPRING BRAKE AFTER ONLY 56 DAYS**





# THE SOLUTION




**Haldex Life Seal® Actuators**

## Haldex Life Seal® Actuators – not your ordinary spring brake.

The spring chamber is totally sealed so contaminants simply cannot get in!

- ✓ No vent holes
- ✓ No filters
- ✓ No caging tool plugs
- ✓ No external breather tubes

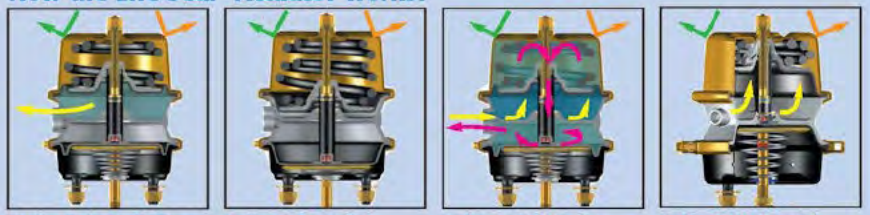
Water, road salt and deicing chemicals that cause corrosion are the worst enemies for the highly stressed steel power spring. Protecting the spring from these corrosive agents is the reason Life Seal® Actuators last so long.

Haldex offers a four (4) year, unlimited mileage warranty on all vocational applications. Refer to L20221 for complete warranty policy details.

**LIFE SEAL® ACTUATOR AFTER 204 DAYS**



## How the Life Seal® Actuator works:



**Parking Brake Application**
Air is exhausted from the parking side. The integral caging tool and push rod maintain alignment as the main spring extends to apply the parking brake.

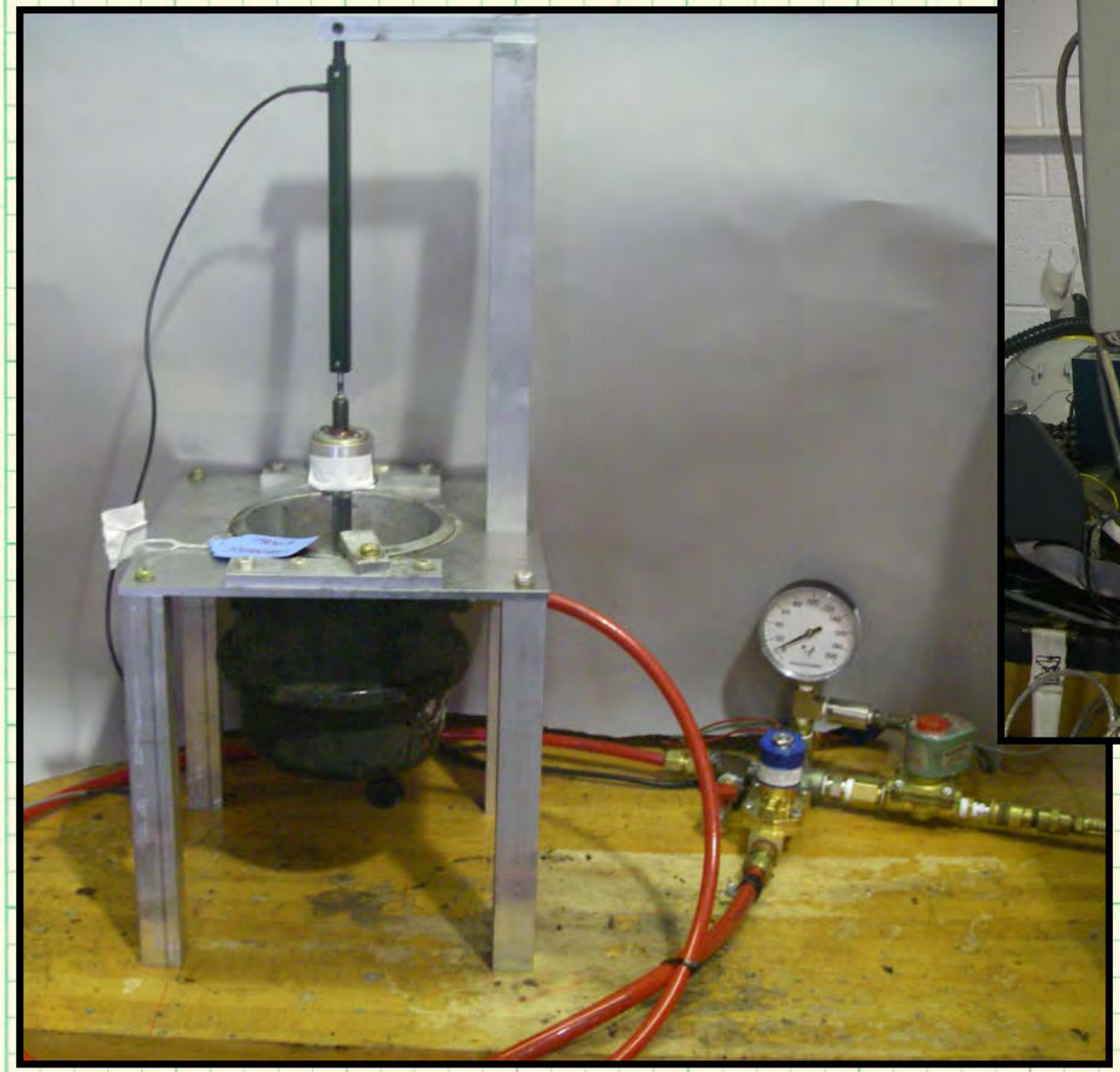
**Parking Brake Applied**
Vehicle parked. The spring chamber is totally sealed, contaminants are prevented from entering the spring chamber.

**Parking Brake Retraction**
Air enters the parking side compressing the main power spring, air in the spring chamber is exhausted down the push rod tube, through an internal valve, and out the vehicle air service side system.

**Parking Brake Retracted**
Vehicle under normal operation. Completely sealed spring chamber prevents road contaminants like water, salt and dirt from attacking the spring.

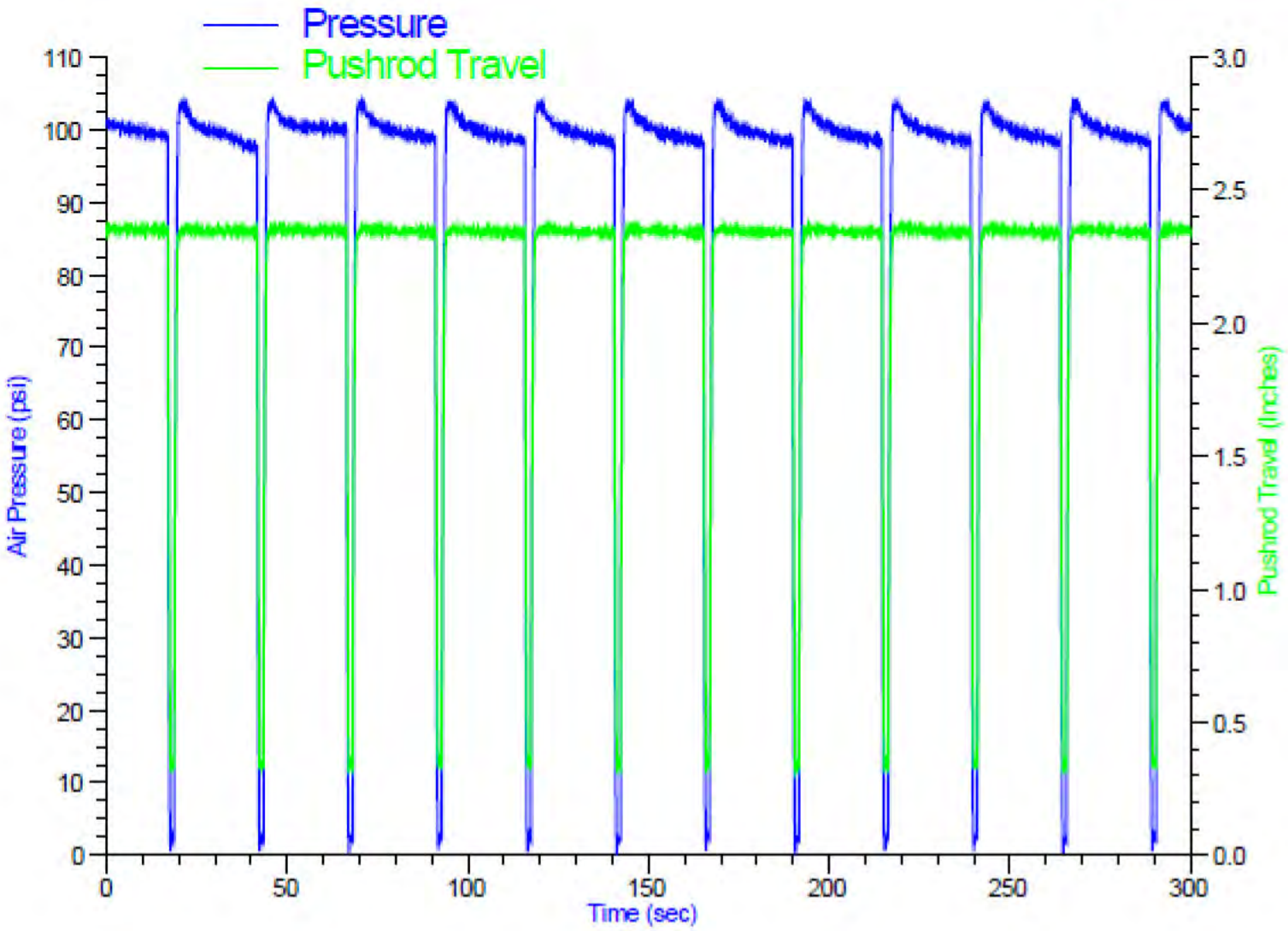


www.haldex.com

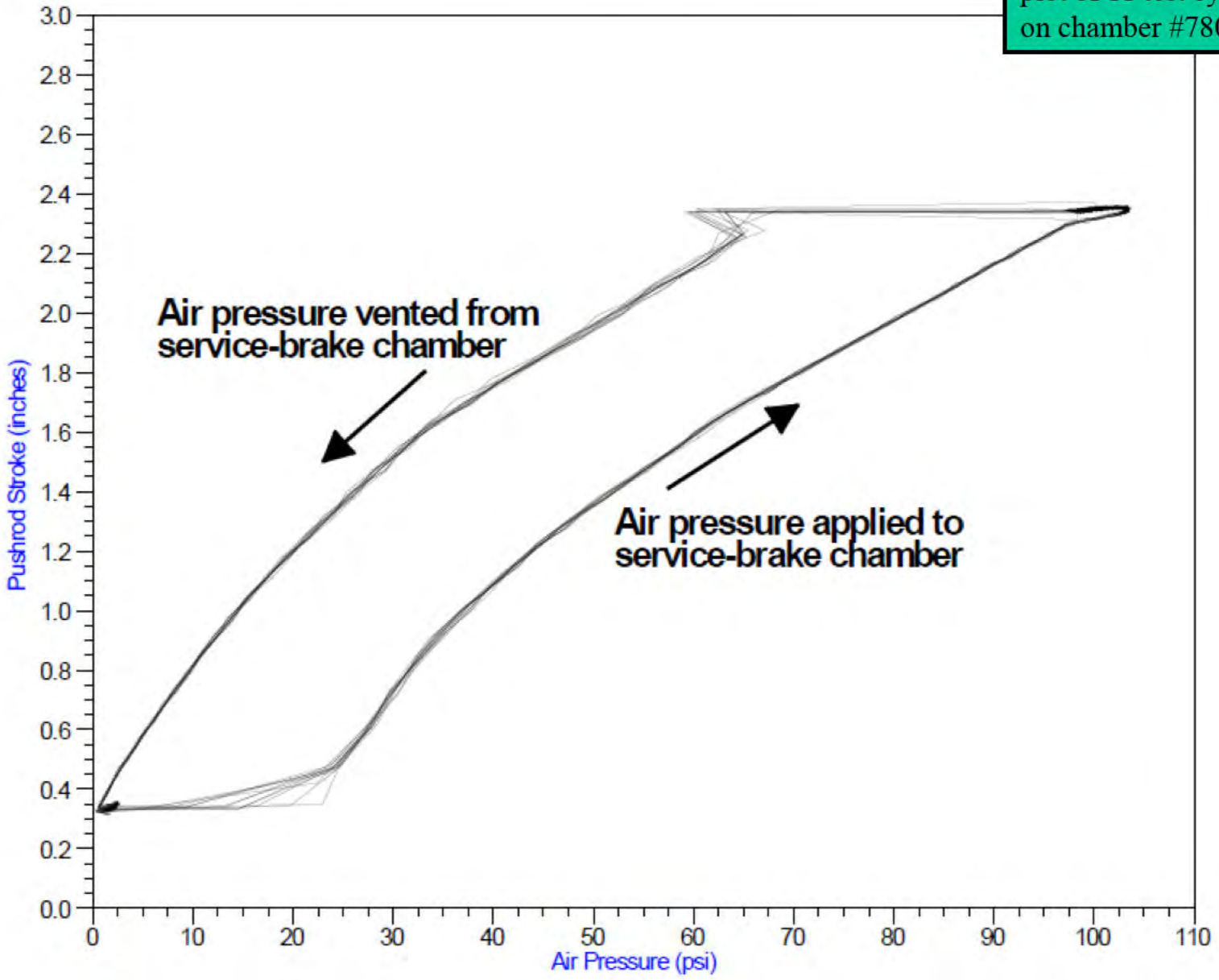




Time history plot of pressure and stroke for 11 test cycles on chamber #78017

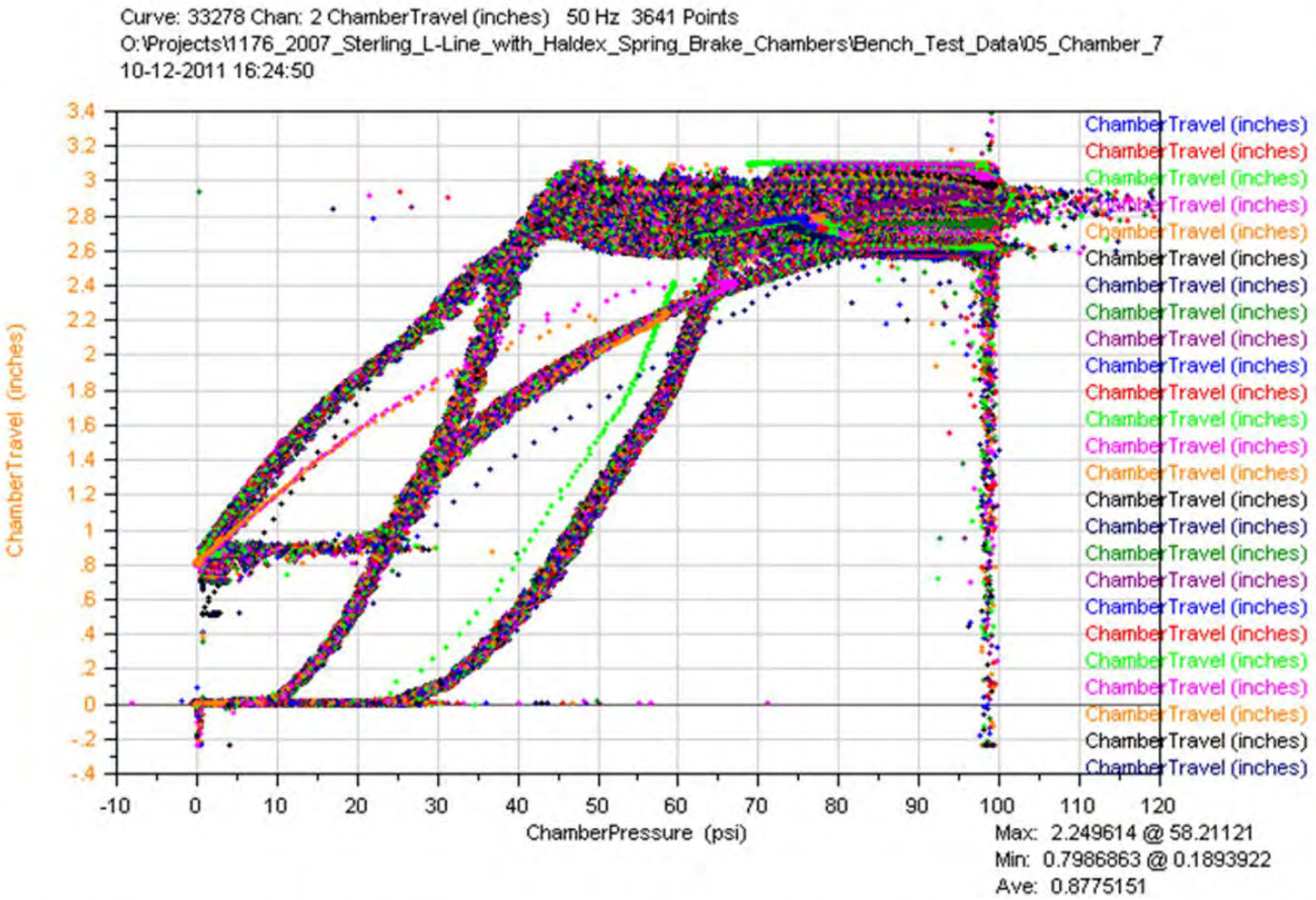


Force vs. displacement plot of 11 test cycles on chamber #78017



Total of 33,278 data curves:

Chamber #77109



| Cassens Transport Information | | Initial Inspection | | | Pushro | n Time/Pre | Cycle | | Final Inspection | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Unit No. | VIN | Drop Test Sound | Exterior Inspection Comments | Actuator Pushrod Position | Bore-Scope Inspection | Push-rod Stroke (in) | Detected Leak | Cycles to Failure | Cycles with Broken Spring | Preliminary Spring Micro Hardness (HV) | Coil Coating Thickness min/max (µm) | Comments |
| 76093 | 2FZHCMCVX6[redacted] | spring vibration | when rotated sand fell out | slightly angled | corrosion | 3.06 | no | 19,734 cycles spring broke, 19,842 cycles diaphragm ruptured | 108 | na | na | spring broken |
| 78063 | 2FZHCMCV57[redacted] | spring vibration | na | straight | corrosion | 2.93 | no | 32,342 & 34,201 cycles spring broke, 34,522 diaphragm ruptured | 2,180 | 586 | 68 | spring was found broken into in three pieces |
| 78109A | 2FZHCMCV77[redacted] | spring vibration | na | straight | corrosion | 2.97 | no | na | na | na | na | unit used as working cutaway for observation in use/driving |
| 78109B | 2FZHCMCV77[redacted] | spring vibration | na | straight | corrosion | 3.06 | no | 32,661 cycles spring broke 33,342 cycles diaphragm ruptured | 681 | na | na | tested horizontally, as mounted on vehcle |
| 78271 | 2FZHCMCV57[redacted] | spring vibration | housing different model | na | corrosion | 3.00 | no | na | na | na | na | built-in caging bolt, larger shaft diameter |
| 76369 | 2FZHCMCV96[redacted] | spring vibration | na | na | broken spring | 2.56 | yes, just on application of shop air | at start spring broken, 16 cycles diaphragm ruptured | 16 | 578 | 0 to 80 | was clunking immediately when started |
| 77109 | 2FZHCMCV9[redacted] | spring vibration | na | straight | corrosion | 3.06 | yes, just on application of shop air | 30,363 cycles spring broke, 33,277 cycles diaphragm ruptured | 2,914 | na | na | pushrod position was at an angle part way throught testing |
| 78017 | 2FZHCMCV4[redacted] | dead | pushrod angled and not returning | angled | broken spring | 2.62 *A 2.06 *B | sometimes at pushrod sleeve | at start spring broken, 7,266 cycles, stopped to save | 7,266+ | na | na | cycle test #1: *A=as rec'd, *B=after 7,266 cycles creaking noise, stopped testing, still intact |
| 77071 | 2FZHCMCVX[redacted] | spring vibration | no tag, number on case | straight | corrosion | 3.06 | no leak heard | 30,328 cycles spring broke, 30,346 cycles diaphragm ruptured | 18 | na | na | no leak at start of cycle testing |
| 78003 | 2FZHCMCV77[redacted] | spring vibration | na | straight | corrosion | 3.06 | yes, pushrod sleeve | 42,968 cycles spring broke, 43,572 cycles diaphragm ruptured | 604 | na | na | small leak, but did not affect cycle testing |
| 76039 | 2FZHCMCV[redacted] | dead | when rotated sand fell out, pushrod angle | angled | broken spring, torn diaphragm | 2.00 | yes, diaphragm ruptured | na | na | 589 | 0 to 68 | pushrod angled, ejected sand, clunks, max press with shop air 98 psi |
| 78023 | 2FZHCMCV[redacted] | dead | housing different size | slightly angled | broken spring, torn diaphragm | 0.63 | yes, diaphragm ruptured | na | na | 591 | 0 to 46 | broken spring blocking cage tool port, max pressure with shop air 46 psi |

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78063
55/100 60



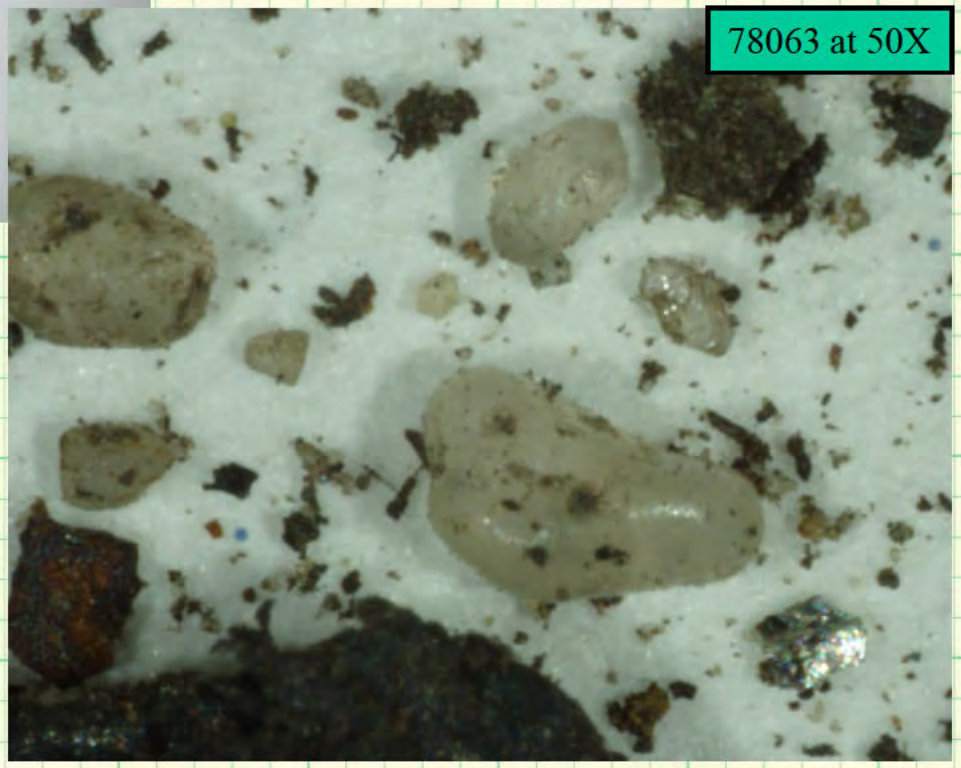









07-25-11
78063
07-25-11
78063


78063 at 50X

# Results of Compound Analyses

## Sample 78063

| Major Constituents of the Powder | Relative Abundance (wt. percent) |
|---|---|
| Quartz: $SiO_2$ | 38.1 |
| Dolomite: $CaMg(CO_3)_2$ | 23.0 |
| Calcite: $Ca(CO_3)$ | 11.0 |
| Microcline ($K(Si_3Al)O_8$) | 10.2 |
| Halite: NaCl | 7.9 |
| Albite ($Na(AlSi_3O_8)$ | 4.6 |
| Iron Oxide Hydroxide: FeO(OH) | 3.9 |
| Magnetite | 1.3 |

BUSINESS SENSITIVE

# VRTC Inspections and Tests of Haldex Spring-Brake Chambers

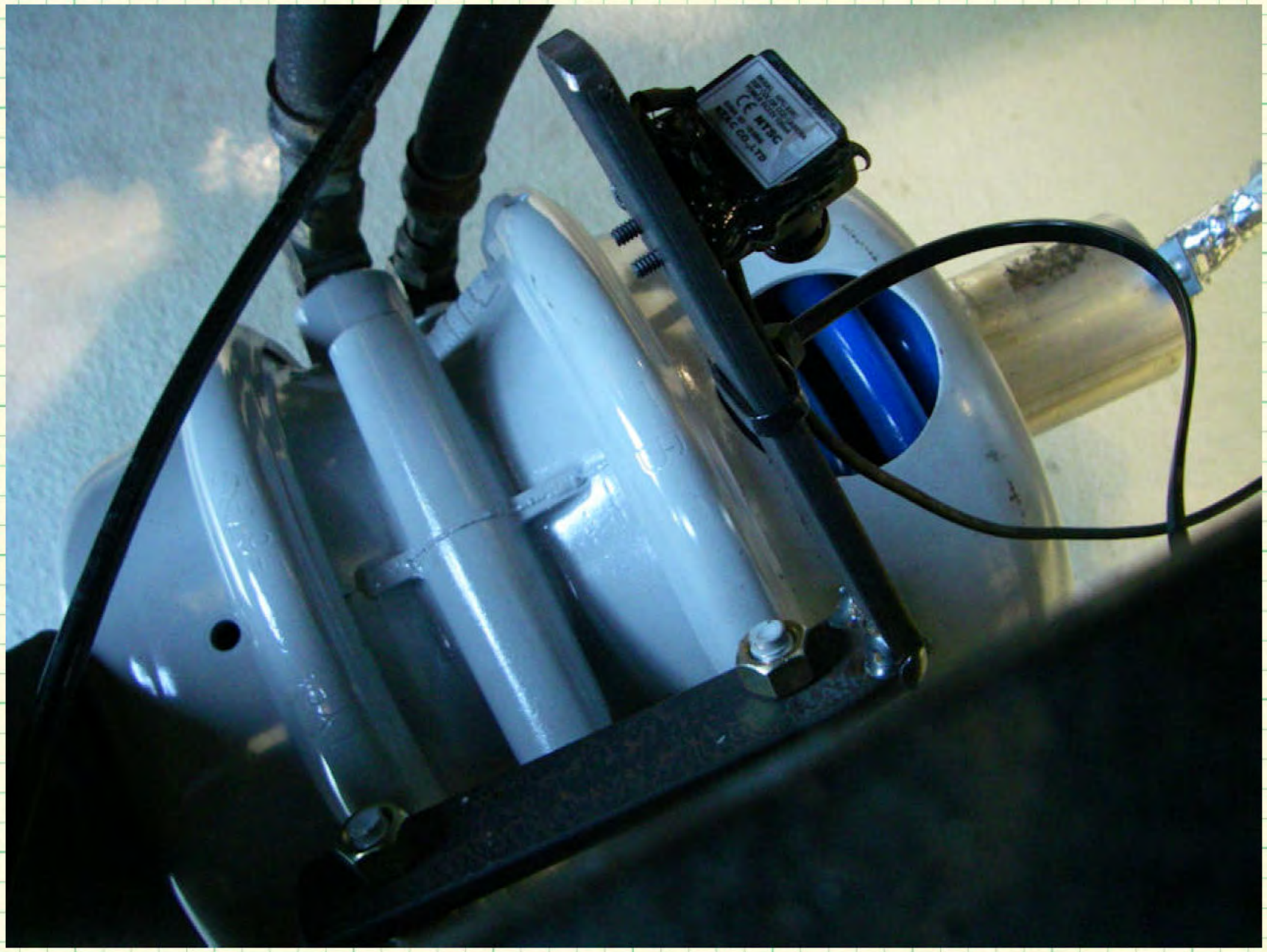
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| Claim Number | Customer Concern and Claim Commments [13 of 126 do not mention air leak] [6 of the 13 mention drag] |
|---|---|
| [redacted] | CUSTOMER STATES LR BRAKE CAN NOT RELEASING. ROAD TEST,VERIFIED CONCERN. RELEASED BRAKES,FOUND LR BRAKE AN NOT RELEASING,STICKING INTERNALLY.CHECKED ALL AIR LINES TO ENSURE THAT NOTHING IN AIR LINES TO CAUSE AIR AN TO PLUG & NOT RELEASE PROPERLY, NOTHING FOUND. REMOVED & REPLACED FAILED LR BRAKE CAN AS NEEDED. REASSEMBLED & ROAD TEST, BRAKE CAN IS NOW RELEASING NORMAL AT THIS TIME. |
| [redacted] | BRAKE CHAMBER NUMBERS ARE HALDEX 108A084/ 1373030214.LEFT REAR DRIVE WHEEL BRAKE CHAMBER IS BINDING UP REPLACED LEFT REAR DRIVE PARK BRAKE CHAMBER THAT HAD SPRING OUT OF PLACE |
| [redacted] | IR FOR BROKEN LR BRAKE CHAMBER LEFT REAR DRIVE PARK BRAKE CHAMBER HAS A BROKEN SPRING IN IT OVEDAND REPLACED LEFT REAR DRIVE PARK BRAKE CHAMBER THAT HAD BROKEN SPRING. HALDEX BRAKE CHAMBER BER HDX 1373030214 258A06A. |
| [redacted] | REPAIR FOR BROKEN SPRING IN BRAKE CHAMBER LEFT REAR DRIVE PARK BRAKE CHAMBER HAS A BROKEN INTERNAL SPR REPLACED CHAMBER ON LRD, CHAMBER HAS A BROKEN INTERNAL SPRING. NUMBERS ON DEFECTIVE BRAKE CHAMBER ARE 13730302/ 192A06A. |
| [redacted] | REPAIR FOR POOR STOPPING POWER LEFT FRONT DRIVE BRAKE CHAMBER HAS A BROKEN SPRIN INSIDE, REPLACED CHAMBER. INSPECT AND FOUND LEFT FRONT BRAKE CHAMBER BROKEN INNER SPRING. REPLACED. NUMBERS ON CHAMBER ARE 1373030214/109A06A. |
| [redacted] | LEFT FRONT DRIVE PARK BRAKE CHAMBER HAS A BROKEN SPRING. LEFT FRONT DRIVE BRAKE CHAMBER HAS A BROKEN SPRING IN IT. RE REMOVED AND REPLACED LEFT FRONT DRIVE PARK BRAKE CHAMBER-IT HAD BROKEN SPRING.. NUMBERS ON CHAMBER ARE 109306A--1373030214... |
| [redacted] | RIGHT REAR REAR BRAKE SMOKING BRAKE CHAMBER WILL NOT FULLY RETRACT. REPLACE BRAKE CHAMBER.FREIGHT IS ON CHAMBER. |
| [redacted] | CHECK RIGHT REAR MAXI CAN (SPRING BROKEN) CONFIRMED SPRING IS BROKEN REPLACED RIGHT REAR MAXI BRAKE CAN ADJUSTED BRAKE |
| [redacted] | R&R BAD MAXI CAN (NEW ONE THAT WAS INSTALLED).INTERNAL SPRING REAR BROKEN. REPLACED ON 11/05/08 MILEAGE - 36104. |
| [redacted] | ARKING BRAKE NOT HOLDING. BROKEN CHAMBER SPRING. INSPECTED. FOUND SPRING BROKEN IN RFDA BRAKE CHAMBER. SCONNECTED AIRLINES. REPLACED CHAMBER. RECONNECTED AIRLINES. TEST, ALL OK. |
| [redacted] | C; CUSTOMER STATES RIGHT REAR BRAKE CHAMBER STICKING.C; DEFECTIVE BRAKE CHAMBER.C; JACK UP REAR & RELEASE RAKES. RIGHT REAR WHEEL STILL LOCKED WILL NOT TURN. INSPECT BRAKE COMPONENTS. SLACK IS NOT RELASES ALL THE WAY. BRAKE CHAMBER NOT RELEASEING ALL THE WAY. R/R BRAKE CHAMBER. CK BRAKE OPERATION WORKING PROPERLY. ATE CODE 05907 (HARD TO READ BUT THINK THIS IS CORRECT). |
| [redacted] | EFT FRONT DRIVE BRAKE LOCKING UP; CHECKED AND FOUND BRAKE CHAMBER CAME APART INSIDE; REMOVE AND REPLACED BRAKE CHAMBER AND ADJUSTED BRAKE; CK OPERATION OK |
| [redacted] | CHECKED WHEEL WHILE SPINNING THE WHEELS. THE RIGHT SIDE WHEELS WAS KNOCKED UP, CHECKED THE BRAKES AND SOMETHING WAS WRONG WITH THE SHOES. PULLED THE WHEELS OFF RIGHT SIDE AND THEN THE DRUM ANDSAW THAT ONE OF THE ROLLERS WAS MISSING. PUT NEW ROLLERS ON AND THEY WORK FINE BUT THE SPRING IN THE LEFT BRAKE CHAMBER WAS BROKE . REPLACED AND IT WAS WORKING FINE. |
| [redacted] | CHECK FOR RIGHT FRONT DRIVE BRAKE CHAMBER STICKING. TECH CHECKED ADJUSTMENT & WATCHED WHILE BRAKES WERE APPLIED, WHE APPLIED NOTHING WAS FOUND. POLICY CLAIM FOR LABOR ONLY. |





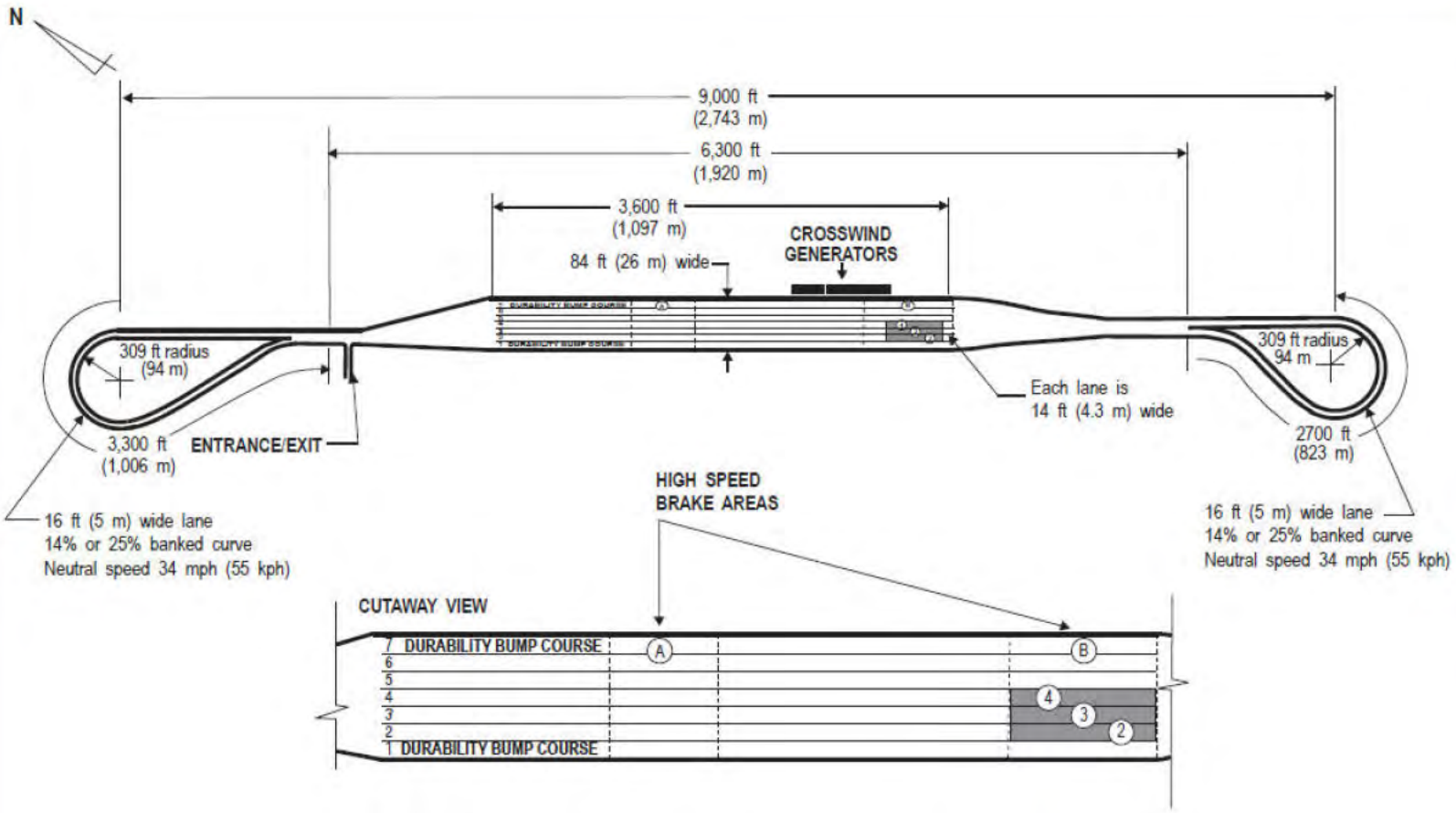













Not to Scale

GVW for Lane 1 and 7 (Asphalt Lanes) = 8,000 lbs (3,636 kgs)

GVW for All Other Lanes (Concrete Lanes) = 80,000 lbs (36,364 kgs)

All Concrete Broomed Surface

1 Lap (Including Loops) = Approximately 4 mi (6.4 klm)

## SKID PAD

TRC®

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F-13 0308

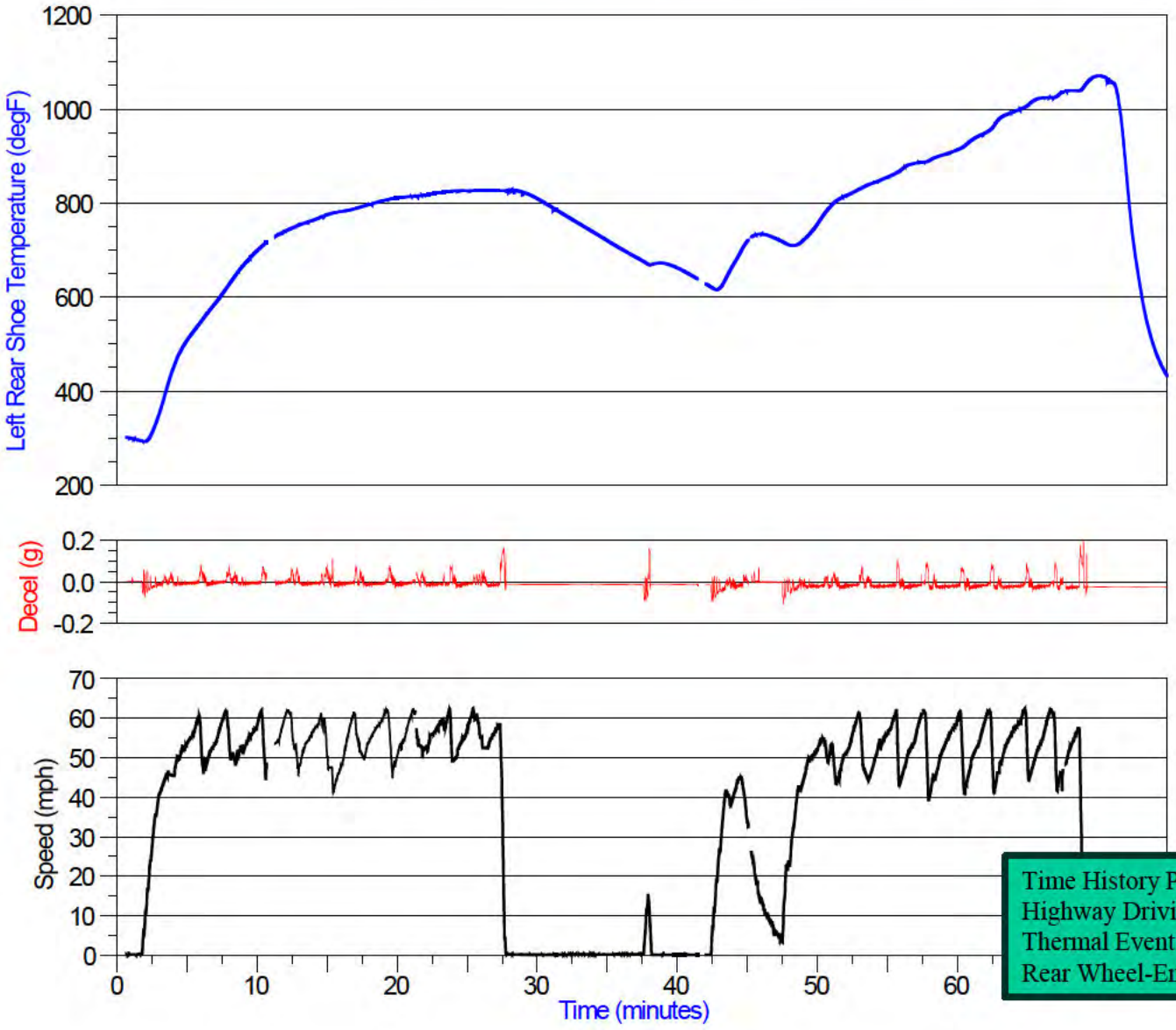
# Simulated Parking Brake Drag Due to Spring Failure

Time into test: 8.5 minutes
Test Conditions: 1,242-lb drag, 0.016-g decel, 33 HP @ 10 mph
Tractor hot wheel end: left rear
Brake lining temp: 577ºF
Detectability: driver reported none

Time into test: 26 minutes
Pre-event: stopped and heat soaked tire during adjustments, driver accelerated for 18 seconds
Event: left-rear inner dual tire blowout @ 36 minutes
Brake lining temp: 675ºF
Detectability: driver heard and stopped

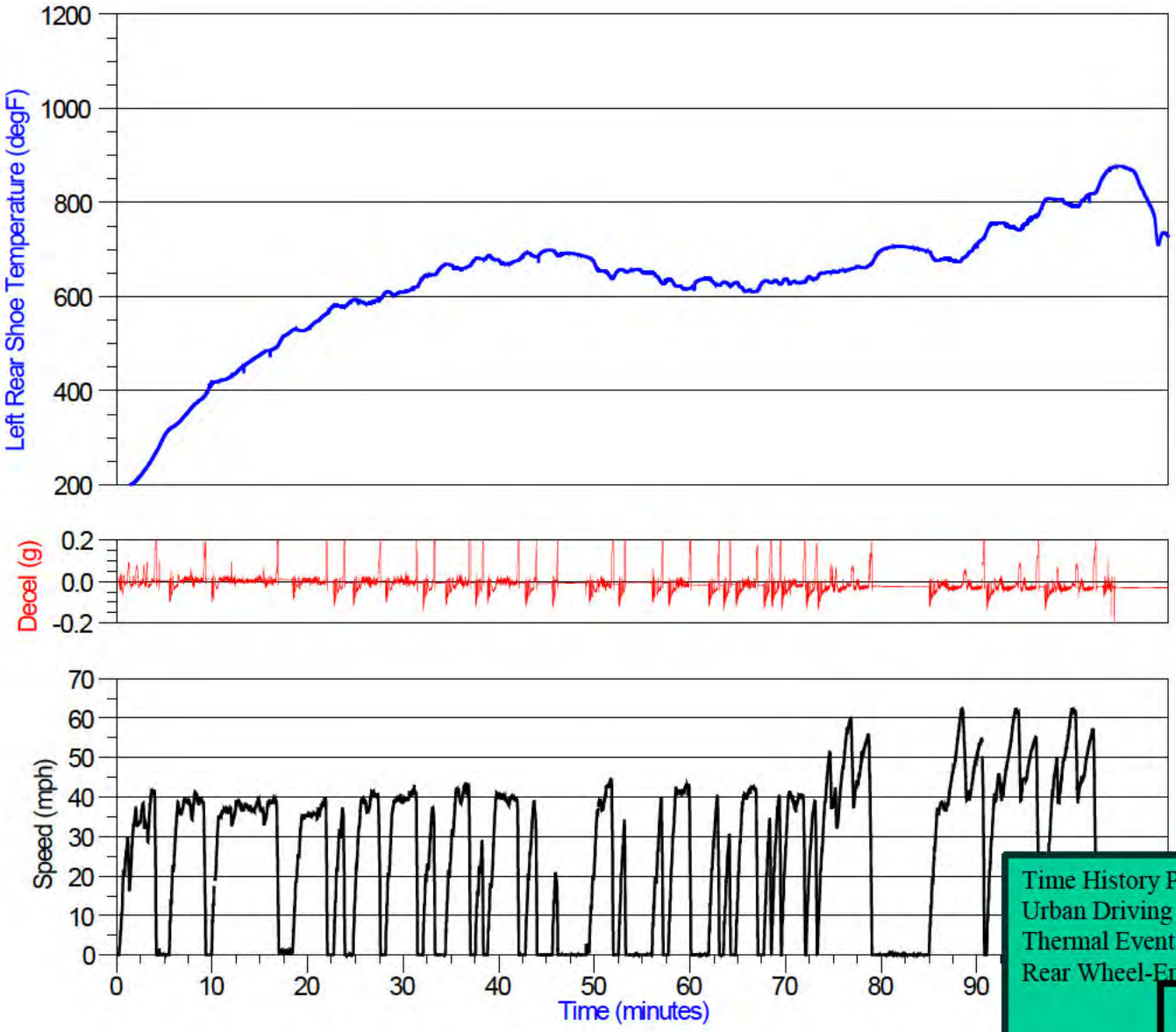
Time into test: 67 minutes
Test Condition: 2,407-lb drag, 0.031-g decel, 64 HP @ 10 mph
Tractor hot wheel end: left rear
Brake lining temp: 1,039ºF
Detectability: driver reported none

FIRE



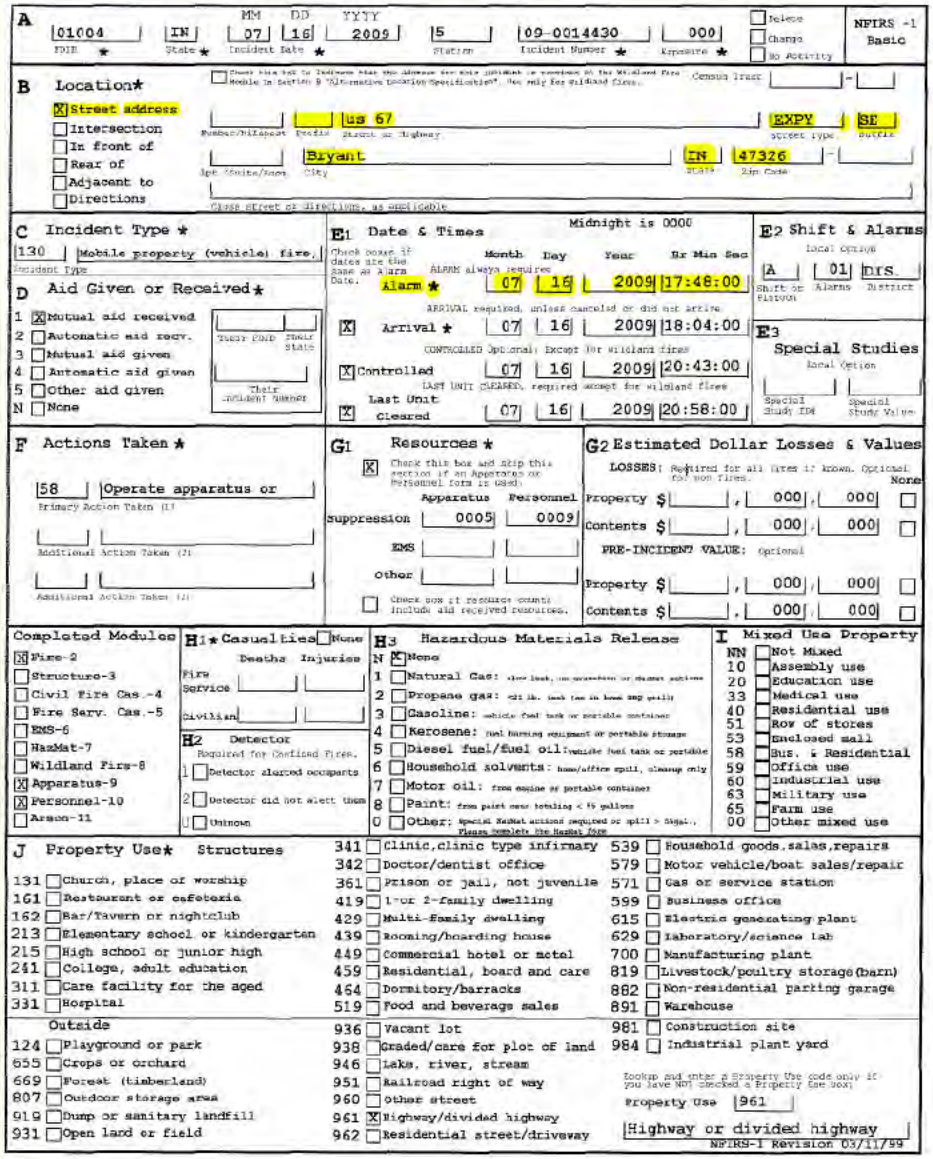

Time History Plot of the Highway Driving Test with Thermal Event at the Left Rear Wheel-End






Time History Plot of the Urban Driving Test with Thermal Event at the Right Rear Wheel-End

FIRE



A
FDID: 01004 | State: IN | Incident Date (MM DD YYYY): 07 16 2009 | Station: 5 | Incident Number: 09-0014430 | Exposure: 000 | Delete / Change / No Activity | NFIRS -1 Basic

B Location
Check this box to indicate that the address for this incident is provided in the Wildland Fire Module in Section B "Alternative Location Specification". Use only for wildland fires. Census Tract
[X] Street address
[ ] Intersection
[ ] In front of
[ ] Rear of
[ ] Adjacent to
[ ] Directions
Number/Milepost: | Prefix: | Street or Highway: US 67 | Street Type: EXPY | Suffix: SE
Apt. Route/Room: | City: Bryant | State: IN | Zip Code: 47326
Cross street or directions, as applicable:

C Incident Type
130 Mobile property (vehicle) fire, other
Incident Type

D Aid Given or Received
1 [X] Mutual aid received
2 [ ] Automatic aid recv.
3 [ ] Mutual aid given
4 [ ] Automatic aid given
5 [ ] Other aid given
N [ ] None
Their FDID: | Their State: | Their Incident Number:

E1 Date & Times (Midnight is 0000)
Check boxes if dates are the same as Alarm Date. ALARM always required.
Alarm * 07 16 2009 17:48:00
ARRIVAL required, unless canceled or did not arrive.
[X] Arrival * 07 16 2009 18:04:00
CONTROLLED Optional; Except for wildland fires
[X] Controlled 07 16 2009 20:43:00
LAST UNIT CLEARED, required except for wildland fires
[X] Last Unit cleared 07 16 2009 20:58:00

E2 Shift & Alarms
Local Option
A | 01 | DFS
Shift or Platoon | Alarms | District

E3 Special Studies
Local Option
Special Study ID: | Special Study Value:

F Actions Taken
58 Operate apparatus or
Primary Action Taken (1)
Additional Action Taken (2)
Additional Action Taken (3)

G1 Resources
[X] Check this box and skip this section if an Apparatus or Personnel form is used.

| | Apparatus | Personnel |
|---|---|---|
| Suppression | 0005 | 0009 |
| EMS | | |
| Other | | |

[ ] Check box if resource counts include aid received resources.

G2 Estimated Dollar Losses & Values
LOSSES: Required for all fires if known. Optional for non fires. None
Property $ , 000 , 000 [ ]
Contents $ , 000 , 000 [ ]
PRE-INCIDENT VALUE: Optional
Property $ , 000 , 000 [ ]
Contents $ , 000 , 000 [ ]

Completed Modules
[X] Fire-2
[ ] Structure-3
[ ] Civil Fire Cas.-4
[ ] Fire Serv. Cas.-5
[ ] EMS-6
[ ] HazMat-7
[ ] Wildland Fire-8
[X] Apparatus-9
[X] Personnel-10
[ ] Arson-11

H1 Casualties [ ] None

| | Deaths | Injuries |
|---|---|---|
| Fire Service | | |
| Civilian | | |

H2 Detector Required for Confined Fires.
1 [ ] Detector alerted occupants
2 [ ] Detector did not alert them
U [ ] Unknown

H3 Hazardous Materials Release
N [X] None
1 [ ] Natural Gas: (low leak, no explosion or minor actions)
2 [ ] Propane gas: (20 lb. tank (as in home BBQ grill))
3 [ ] Gasoline: (vehicle fuel tank or portable container)
4 [ ] Kerosene: (fuel burning equipment or portable storage)
5 [ ] Diesel fuel/fuel oil: (vehicle fuel tank or portable)
6 [ ] Household solvents: (home/office spill, cleanup only)
7 [ ] Motor oil: (from engine or portable container)
8 [ ] Paint: (from paint cans totaling < 55 gallons)
0 [ ] Other: (Special HazMat actions required or spill > 55gal...) Please complete the HazMat form

I Mixed Use Property
NN [ ] Not Mixed
10 [ ] Assembly use
20 [ ] Education use
33 [ ] Medical use
40 [ ] Residential use
51 [ ] Row of stores
53 [ ] Enclosed mall
58 [ ] Hot. & Residential
59 [ ] Office use
60 [ ] Industrial use
63 [ ] Military use
65 [ ] Farm use
00 [ ] Other mixed use

J Property Use * Structures

| | | | |
|---|---|---|---|
| 131 | Church, place of worship | 341 | Clinic,clinic type infirmary |
| 161 | Restaurant or cafeteria | 342 | Doctor/dentist office |
| 162 | Bar/Tavern or nightclub | 361 | Prison or jail, not juvenile |
| 213 | Elementary school or kindergarten | 419 | 1-or 2-family dwelling |
| 215 | High school or junior high | 429 | Multi-family dwelling |
| 241 | College, adult education | 439 | Rooming/boarding house |
| 311 | Care facility for the aged | 449 | Commercial hotel or motel |
| 331 | Hospital | 459 | Residential, board and care |
| | | 464 | Dormitory/barracks |
| | | 519 | Food and beverage sales |
| 539 | Household goods,sales,repairs | | |
| 579 | Motor vehicle/boat sales/repair | | |
| 571 | Gas or service station | | |
| 599 | Business office | | |
| 615 | Electric generating plant | | |
| 629 | Laboratory/science lab | | |
| 700 | Manufacturing plant | | |
| 819 | Livestock/poultry storage(barn) | | |
| 882 | Non-residential parking garage | | |
| 891 | Warehouse | | |

Outside

| | | | |
|---|---|---|---|
| 124 | Playground or park | 936 | Vacant lot |
| 655 | Crops or orchard | 938 | Graded/care for plot of land |
| 669 | Forest (timberland) | 946 | Lake, river, stream |
| 807 | Outdoor storage area | 951 | Railroad right of way |
| 819 | Dump or sanitary landfill | 960 | Other street |
| 931 | Open land or field | 961 | [X] Highway/divided highway |
| | | 962 | Residential street/driveway |
| 981 | Construction site | | |
| 984 | Industrial plant yard | | |

Lookup and enter a Property Use code only if you have NOT checked a Property Use box:
Property Use 961
Highway or divided highway

NFIRS-1 Revision 03/11/99

Geneva Volunteer Fire Department 01004 07/16/2009 09-0014430

Geneva Volunteer Fire Department 01004 07/16/2009 09-0014430

A
FDID: 01004 | State: IN | Incident Date (MM DD YYYY): 07 16 2009 | Station: 5 | Incident Number: 09-0014430 | Exposure: 000 | Delete / Change / No Activity | NFIRS -2 Fire

B Property Details
B1 [ ] [X] Not Residential
Estimated number of residential living units in building of origin whether or not all units became involved
B2 [ ] [X] Buildings not involved
Number of buildings involved
B3 [ ] Acres Burned (outside fires) [ ] None [X] Less than one acre

C On-Site Materials [ ] None
Enter up to three codes. Check one or more boxes for each code entered. Complete if there was any significant amounts of commercial,industrial, energy or agricultural products or materials on the Property, whether or not they became involved
On-site material (1): 1 [ ] Bulk storage or warehousing 2 [ ] Processing or manufacturing 3 [ ] Packaged goods for sale 4 [ ] Repair or service
On-site material (2): 1 [ ] Bulk storage or warehousing 2 [ ] Processing or manufacturing 3 [ ] Packaged goods for sale 4 [ ] Repair or service
On-site material (3): 1 [ ] Bulk storage or warehousing 2 [ ] Processing or manufacturing 3 [ ] Packaged goods for sale 4 [ ] Repair or service

D Ignition
D1 82 Cargo/trunk area - all
Area of Fire origin *
D2 00 Heat source: other
Heat source *
D3 00 Item First Ignited,
Item First Ignited * 1 [ ] Check box if fire spread was confined to object of origin
D4 00 Type of material first
Type of Material first ignited | Required only if item first ignited code (1 00 or 70)

E1 Cause of Ignition
Check box if this is an exposure report.
1 [ ] Intentional
2 [X] Unintentional
3 [ ] Failure of equipment or heat source
4 [ ] Act of nature
5 [ ] Cause under investigation
U [ ] Cause undetermined after investigation

E2 Factors Contributing To Ignition [ ] None
20 Mechanical
Factor Contributing To Ignition (1)
Factor Contributing To Ignition (2)

E3 Human Factors Contributing To Ignition
Check all applicable boxes
1 [ ] Asleep [X] None
2 [ ] Possibly impaired by alcohol or drugs
3 [ ] Unattended person
4 [ ] Possibly mental disabled
5 [ ] Physically Disabled
6 [ ] Multiple persons involved
7 [ ] Age was a factor
Estimated age of person involved
1 [ ] Male 2 [ ] Female

F1 Equipment Involved In Ignition
[ ] None If Equipment was not involved,Skip to Section G
Equipment Involved
Brand
Model
Serial #
Year

F2 Equipment Power
Equipment Power Source

F3 Equipment Portability
1 [ ] Portable
2 [ ] Stationary
Portable equipment normally can be moved by one person, is designed to be used in multiple locations, and requires no tools to install.

G Fire Suppression Factors
Enter up to three codes. [ ] None
Fire suppression factor (1)
Fire suppression factor (2)
Fire suppression factor (3)

H1 Mobile Property Involved [ ] None
1 [ ] Not involved in ignition, but burned
2 [ ] Involved in ignition, but did not burn
3 [X] Involved in ignition and burned

H2 Mobile Property Type & Make
20 Freight road transport
Mobile property type
FO Ford
Mobile property make
starling
Mobile property model
2007
Year
P656163
License Plate Number
IL
State
2f2hcmcv2[redacted]
VIN Number

Local Use
[ ] Pre-Fire Plan Available
Some of the information presented in this report may be based upon reports from other Agencies
[ ] Arson report attached
[ ] Police report attached
[ ] Coroner report attached
[ ] Other reports attached

NFIRS-2 Revision 01/19/99

This gentleman SAW AND HEARD THE whole thing

## WITNESS CARD

Did you see the accident? ____ Did anyone appear injured? ____ Were you riding in a vehicle involved? NO Which one? ____ Who do you think was responsible for the accident? ____

Your Name [redacted]

Address [redacted] STATE KS 67 [redacted]

Phone [redacted]

**PLEASE RETURN THIS CARD TO THE DRIVER**

Thank You!

ALSO CALLED 911

## WHAT HAPPENED

At what distance did you first see danger? N/A Ft.

How fast were you going? 50 MPH

What was your speed at impact? N/A MPH

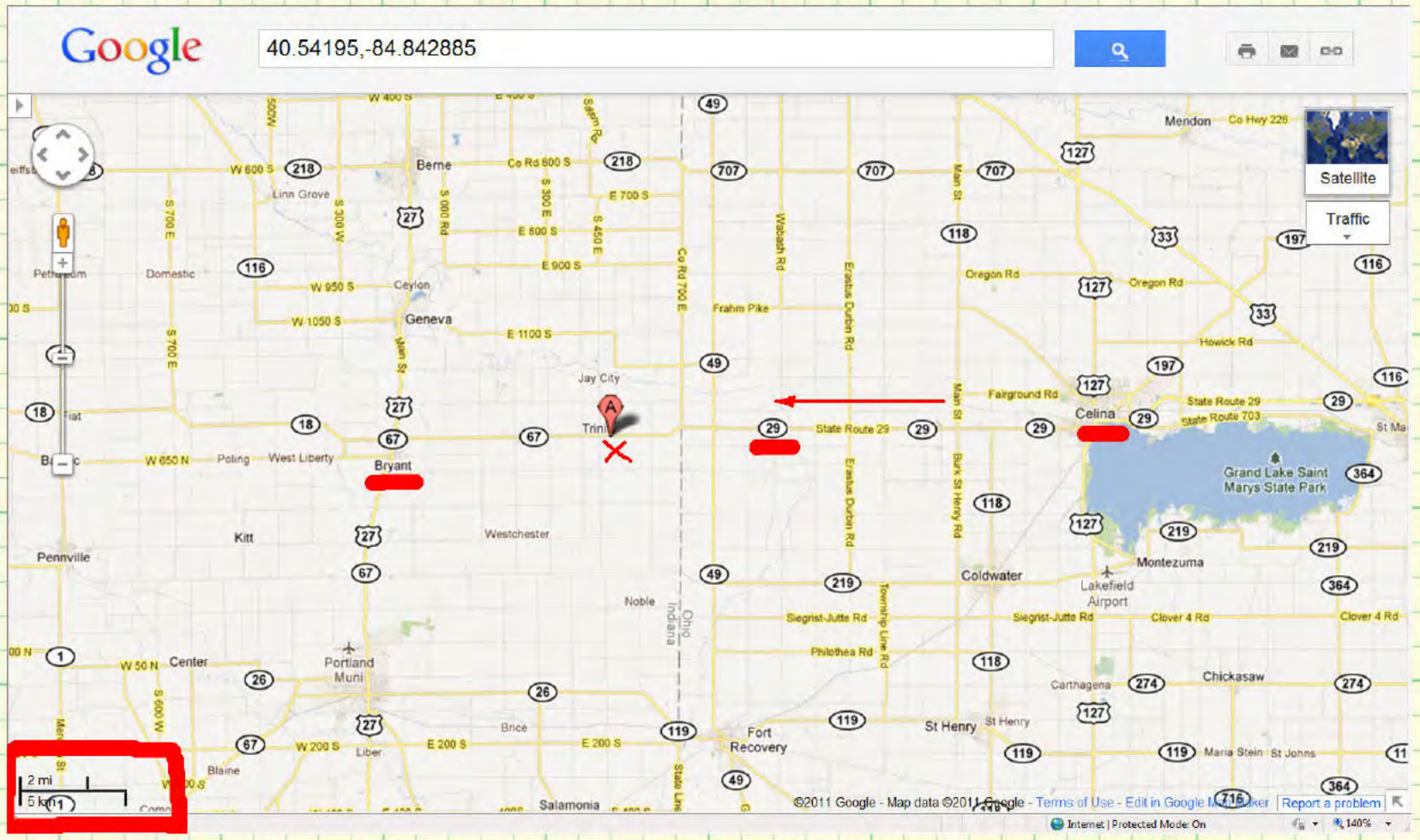
How far did your vehicle go after impact? N/A Ft.

Describe in your own words the circumstances of the ~~accident~~ INCIDENT/FIRE

I LOADED A TENCHE LOAD FROM THREE YARDS AND WAS ENROUTE TO KOKOMO, IN FOR FIRST DROP. I WAS HEADED WESTBOUND 3 MILES WEST OF INDIANA STATE LINE ON ROUTE 67 WHEN I HEARD A LOUD BANG. I PULLED OVER WITHIN 30 TO 40 FEET ON SHOULDER BECAUSE I THOUGHT I HAD A BLOW OUT. DIDN'T SEE ANY THING ON DRIVER SIDE OF TRACTOR BUT WHEN I LOOKED PASSENGER SIDE OF TRACTOR IT APPEARED ALL WAS WELL EXCEPT AN ORANGE GLOW COMING FROM THE #5 TIRE - THE INSIDE TIRE ON #3 AXLE. A CLOSER EXAMINATION SHOWED THE ORANGE GLOW WAS ACTUALLY FLAMES. I IMMEDIATELY GOT THE FIRE EXTINGUISHER FROM THE CAB AND ATTEMPTED TO PUT THE FIRE OUT FROM DIFFERENT ANGLES UNTIL THE EXTINGUISHER WAS EXHAUSTED. AT THAT POINT THE FLAMES APPEARED TO BE OUT OF CONTROL. I IMMEDIATELY GOT MY OWN PHONE CALLED 911; MARYSVILLE SHOP AND TERMINAL MANAGER GARY ROBERTSON. I THEN ATTEMPTED TO REMOVE PERSONAL ITEMS FROM TRACTOR UNTIL FIRE BECAME TOO INTENSE CAUSING EXPLOSIONS ALL ALONG THE TRUCK. FIRE DEPARTMENT ARRIVED TO PUT OUT FIRE. ONLY ONE ONE #6 AXLE CONTINUED THE FIRE.

Date 7-17-09

[redacted]


Google
40.54195,-84.842885
Satellite
Traffic
Mendon
Co Hwy 226
Berne
Linn Grove
Co Rd 600 S
W 600 S
Ceylon
Geneva
W 950 S
W 1050 S
E 1100 S
Jay City
Trinway
Bryant
Poling
West Liberty
W 650 N
Kitt
Westchester
Pennville
Noble
Ohio
Indiana
Portland Muni
Center
W 50 N
Brice
Liber
W 200 S
E 200 S
Blaine
Salamonia
Fort Recovery
State Line
Frahm Pike
Co Rd 700 E
Wabash Rd
Erastus Durbin Rd
Main St
Bark St
Henry Rd
Township Line Rd
Oregon Rd
Howick Rd
Fairground Rd
State Route 29
Celina
Grand Lake Saint Marys State Park
Coldwater
Montezuma
Lakefield Airport
Siegrist-Jutte Rd
Philothea Rd
Clover 4 Rd
Carthagena
Chickasaw
St Henry
Maria Stein
St Johns
2 mi
5 km
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Report a problem
Internet | Protected Mode: On
140%

# VRTC Inspections and Tests of Haldex Spring-Brake Chambers

- Inspection and bench tests of chambers removed from service
- Disassembly, inspection, testing of debris
- Vehicle tests for unintended brake drag and parking brake operation
- Metallurgy of the power spring
- Comparison to peer spring-brake chamber
- Summary



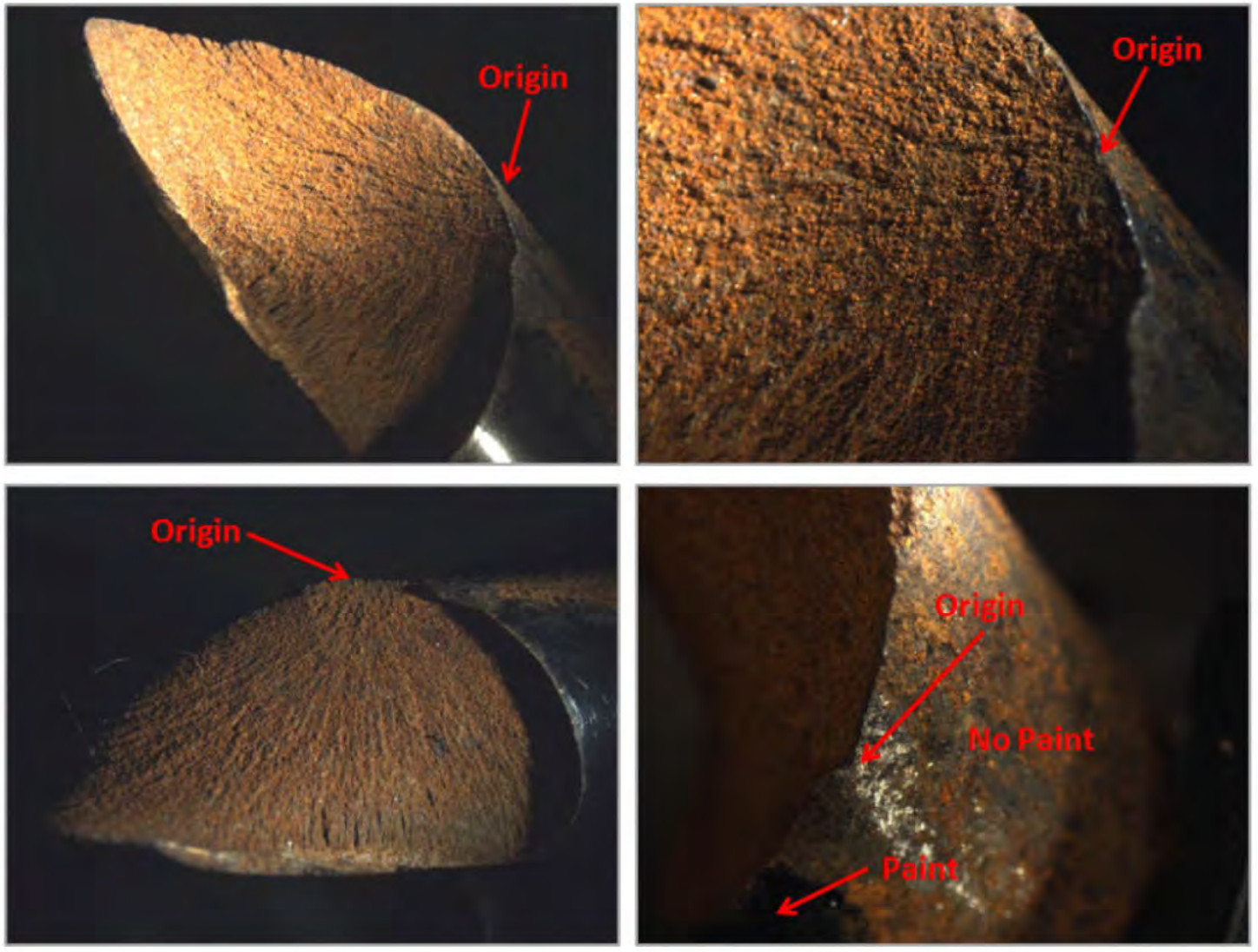
# Intertek APTECH examined specimens from two Haldex springs

- Materials chemistry and microstructure appear to be within specified limits
- The power springs failed due to torsional fatigue initiated at a corrosion pit on the spring OD caused by corrosion of the exposed steel in the environment in regions where the paint had de-bonded from the spring surface
- Abrasion of the paint by clashing of spring coils was accelerated through interaction with debris causing it to de-bond in sections from the surface of the spring

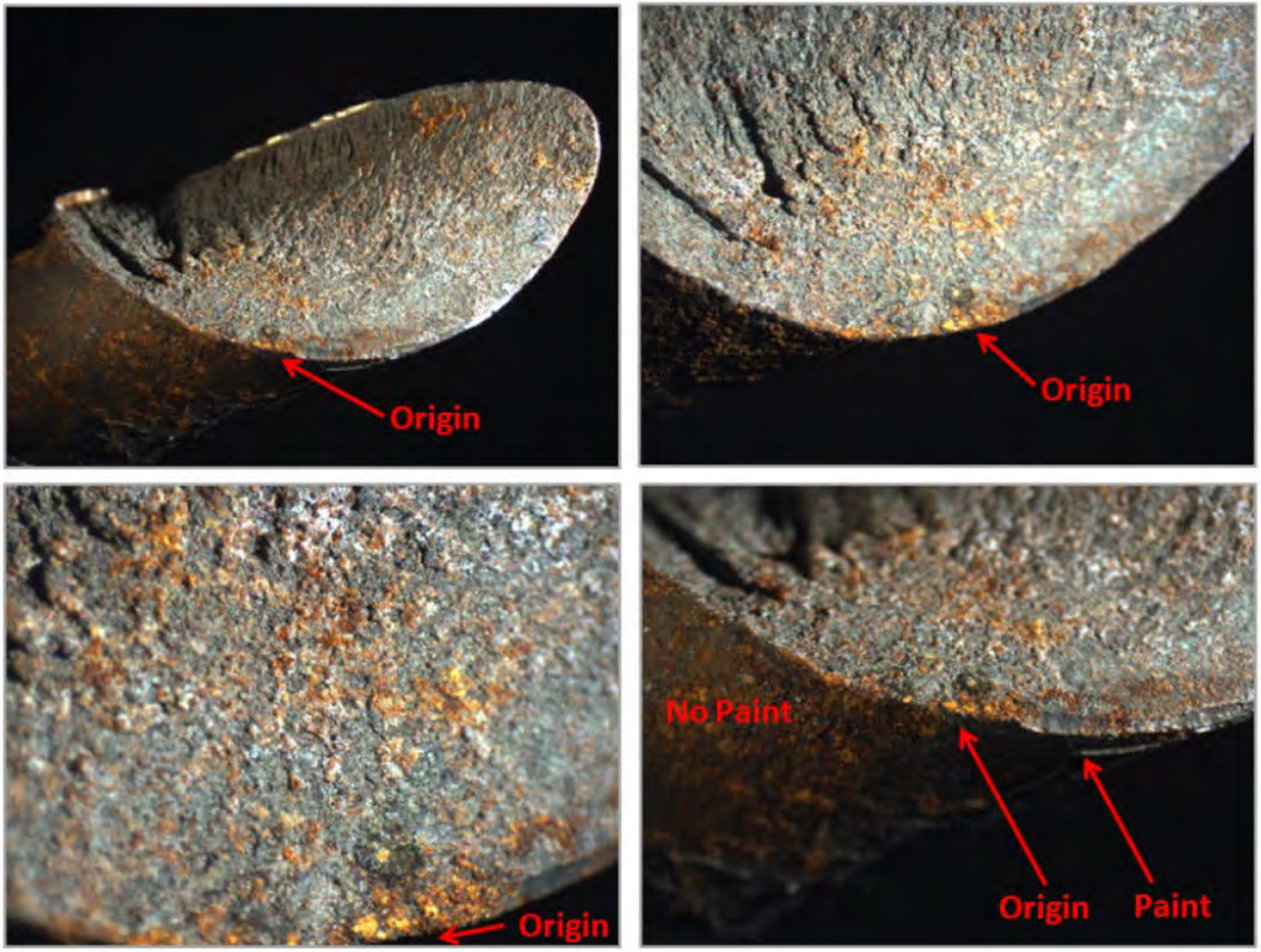
# Intertek APTECH examined specimens from two Haldex springs

- The acceptance criteria in ESF-3029-F were flawed in that they allowed exposed metal caused by coil clashing or contact with spring supports to pass inspection. It is recommended that these criteria be changed to only allow springs to pass with a complete coating of paint remaining after testing. Again, the mechanical design should be changed to avoid coil clashing, or at the very least specify a more durable protective coating.

# Intertek APTECH examined specimens from two Haldex springs



# Intertek APTECH examined specimens from two Haldex springs



# Institute for Spring Technology examined specimens from two Haldex springs

- The microstructure appeared to be appropriate with even grain structure for high strength
- The maximum stresses in a coil spring are along the inner diameter, these failed at the coil to coil contact points
- With any spring of this nature, if the coating is breached locally, corrosion will occur causing pitting and stress risers and then the spring will fail quickly
- It is not appropriate for the spring coils to contact each other in normal use

# VRTC Inspections and Tests of Haldex Spring-Brake Chambers

- Inspection and bench tests of chambers removed from service
- Disassembly, inspection, testing of debris
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- Summary

# VRTC Inspections and Tests of Haldex Spring-Brake Chambers



The power Spring in the Haldex chamber and the MGM chamber appear identical



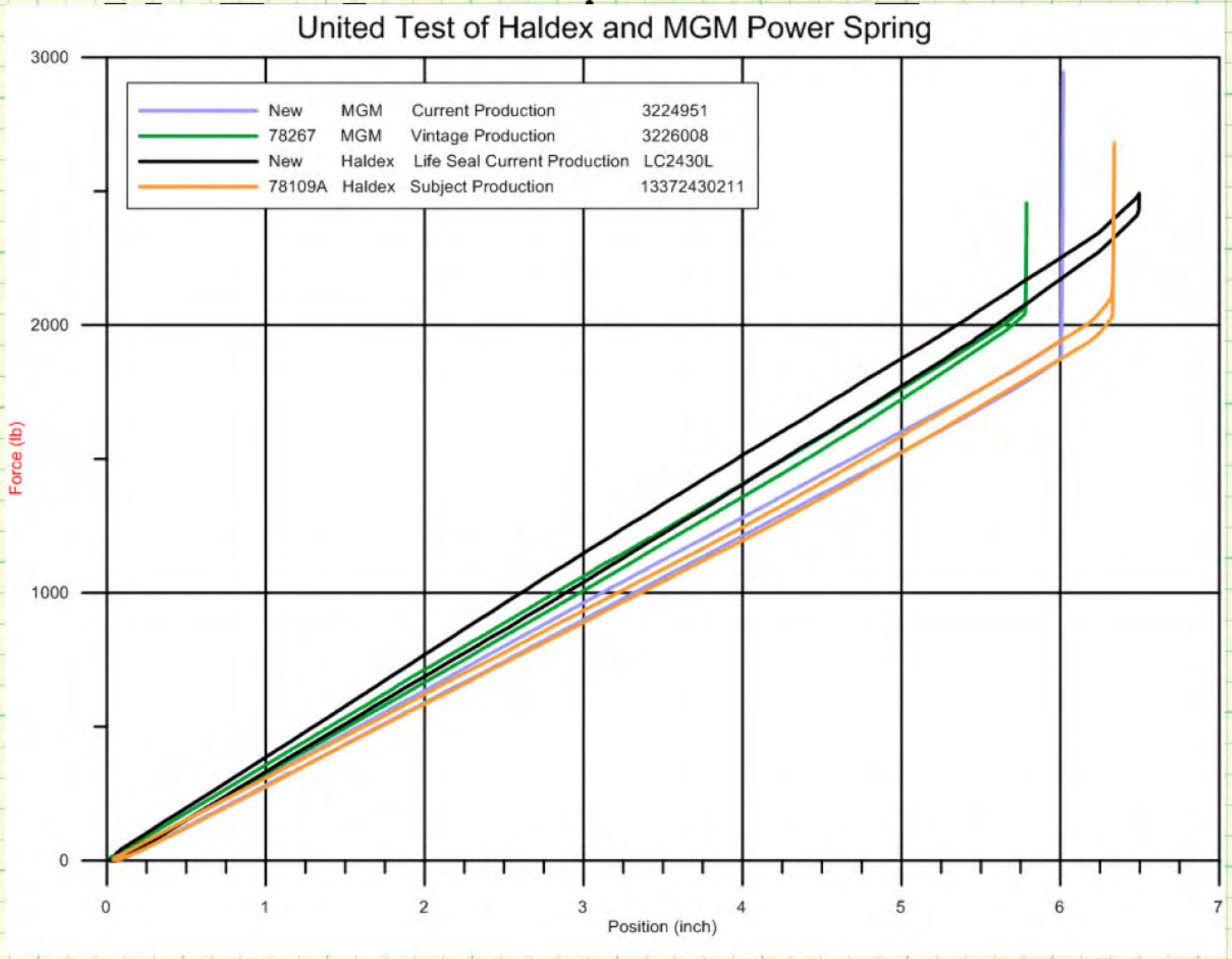
# VRTC Inspections and Tests of Haldex Spring-Brake Chambers

| Power Spring Comparisons<br>Measured Physical Dimensions and Spring Constant | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Spring-Brake Chamber Manufacturer | Chamber Data Plate Number | Free Length (inch) | Maximum Spring OD at Free Length (inch) | Minimum Spring OD at Free Length (inch) | Wire Diameter (inch) | Total Wire Length (inch) | Minimum Working Height (inch) | Spring Constant (lb/inch) |
| Subject Haldex | 13372430211 | 7.87 | 5.39 | 3.72 | 0.52 | 64.00 | 1.47 | 282 |
| Vintage MGM | 3226008 | 7.68 | 5.39 | 3.54 | 0.53 | 64.00 | 1.88 | 354 |

The power Spring in the Haldex chamber is reported to have a solid height at 1.43 inches

# VRTC Inspections and Tests of Haldex Spring-Brake Chambers

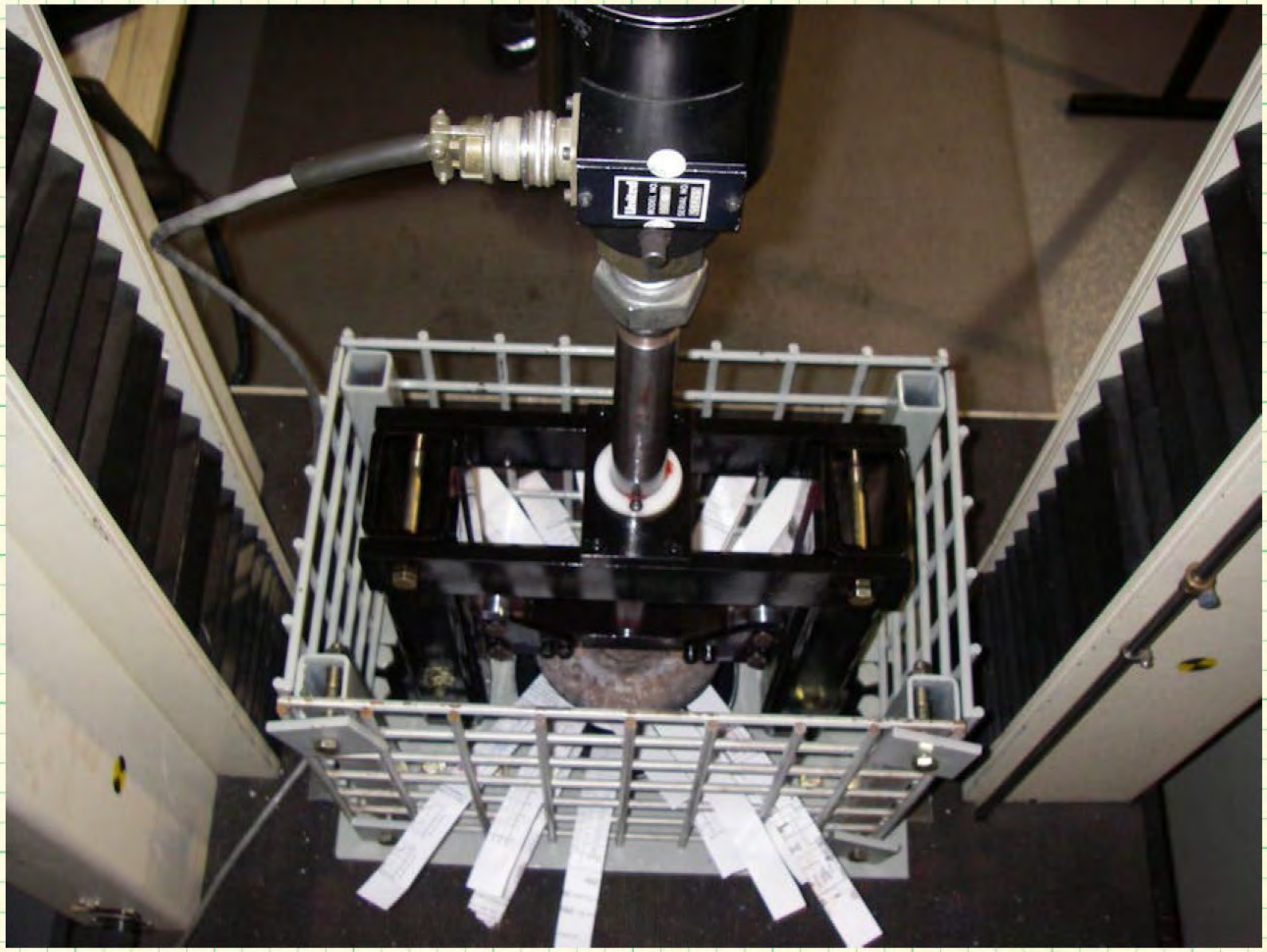



United Test of Haldex and MGM Power Spring
New MGM Current Production 3224951
78267 MGM Vintage Production 3226008
New Haldex Life Seal Current Production LC2430L
78109A Haldex Subject Production 13372430211
Force (lb)
3000
2000
1000
0
0
1
2
3
4
5
6
7
Position (inch)

# VRTC Inspections and Tests of Haldex Spring-Brake Chambers

| Power Spring Comparisons<br>Surface Length of Corrosion | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Spring-Brake Chamber Manufacturer | Chamber Data Plate Number | Total Wire Length (inch) | Wire Length of "Center" of Spring [Excludes 1.5 Turns at Each End] (inch) | Total Length of Wire Found Corroded on "Top" (inch) | Total Length of Wire Found Corroded on "Bottom" (inch) | Total Length of Wire Found Corroded in "Center" and on "Top" (inch) | Total Length of Wire Found Corroded in "Center" and on "Bottom" (inch) | Percent of "Center" Wire Found Corroded "Top"+"Bottom" (inch) |
| Subject Haldex | 13372430211 | 64.00 | 25.50 | 17.25 | 19.00 | 6.50 | 11.50 | 18.00 |
| Vintage MGM | 3226008 | 64.00 | 26.25 | 6.50 | 11.50 | 1.25 | 1.75 | 3.00 |

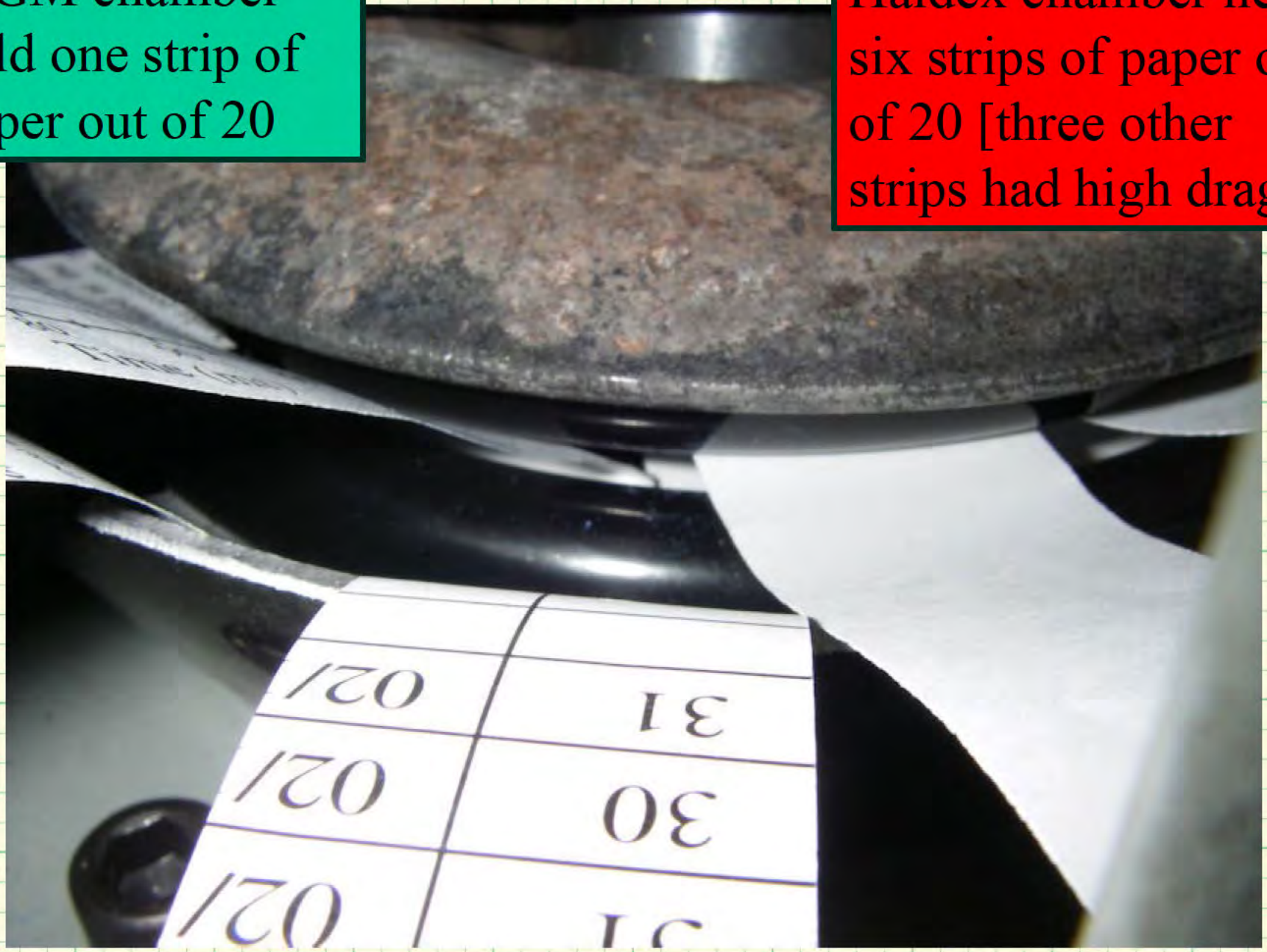





TruckSim Run
TSA Experimental Run
2
3
4
5
Time (sec)
0
10
20

MGM chamber held one strip of paper out of 20

Haldex chamber held six strips of paper out of 20 [three other strips had high drag]



# Summary

- Twelve spring-brake chambers collected at local autohauler were found with springs that had missing paint, corrosion, Halite (NaCl) debris
- Six of eight chambers subjected to durability testing continued to operate with a broken power spring for 108 to 7,266+ cycles (for an average of 2,292 cycles) compromising the stroke on some actuators, this failure is not detectable upon normal pre-trip inspection (unless raise vehicle and check for drag)
- Testing on the test track showed little detectability (visible smoke or vehicle deceleration) and similar sequence of events as occurred during the reported autohauler fire
- The parking portion of the spring brake was found to deploy at 63 psi, audible alarm and dash light at 60 psi, and dash knobs popped at 25 psi, a variable leak was created at the pressure hose attached to the spring-brake chamber at the right forward drive axle, and found multiple brakes would be applied
- Similar Haldex and MGM springs are compressed to a shorter minimum working height in the Haldex design

# End of Presentation

Dan Pearse
Federal Vehicle Safety Engineer
United States Department of Transportation
National Highway Traffic Safety Administration
Vehicle Research & Test Center - Defects Analysis Group
Dan.Pearse@nhtsa.dot.gov  937-666-4511