


INFORMATION Redacted PURSUANT TO THE FREEDOM OF
INFORMATION ACT (FOIA), 5 U.S.C. 552(B)(6)

 <p align="center">DOT Auto Safety Hotline Vehicle Owner's Questionnaire To Report Vehicle Safety Defects 1-888-DASH-2-DOT (1-888-327-4236) INTERNET:www.nhtsa.dot.gov/hotline</p>			FOR AGENCY USE ONLY 100148		
<p>U.S. Department of Transportation National Highway Traffic Safety Administration</p>			Date Received 16-JUN-2015	Repository <input type="checkbox"/> Reference No. 10725608	
OWNER INFORMATION (Type or Print)					
Name		[REDACTED]		Telephone Number	
Address		[REDACTED]		[REDACTED]	
City KANSAS CITY		State MO	Zip Code [REDACTED]		
<p><i>The information you provide will be used to identify potential safety-related defects. We may share your information with the applicable vehicle manufacturer during an investigation or recall in accordance with the routine uses described in the agency's Privacy Act notice. See 49 FR 53971 (Sep. 3, 2004).</i></p>					
VEHICLE INFORMATION					
17 digit Vehicle Identification Number Located at bottom of windshield on driver's side 3FTNF21F01M [REDACTED]			Make FORD	Model F-250 SD	Model Year 2001
Date Purchased	Dealer's Name and Telephone Number			Engine: No: Cylinders	Fuel Type:
Original Owner <input type="checkbox"/>	Dealer's City		State	Zip Code	
Transmission Type	<input type="checkbox"/> Antilock Brakes	Powertrain	Multiple Failure:		Incident Date(s) 12-SEP-2011
	<input type="checkbox"/> Cruise Control				
FAILED COMPONENT(S)/PART(S) INFORMATION					
Vehicle Component Codes: 190000 TIRES, 190000 TIRES				Failure Mileage 42498	Failure Speed
ADDITIONAL ITEMS TO BE COMPLETED WHEN REPORTING A TIRE FAILURE					
Tire Make KUMHO	Tire Model (Name or Number) ROAD VENTURES		Tire Size (Example P215/65R15) * 235/85R16		
DOT No. (Example: DOTM19ABC036) K20R YD4A 3508	<input type="checkbox"/> Original Equipment <input type="checkbox"/> Prior Repair		Failure Location: PASSENGER SIDE FRONT		
Tire Component Code 190000 TIRES			Tire Failure Type: TREAD SEPARATION		
ADDITIONAL ITEMS TO BE COMPLETED WHEN REPORTING A CHILD SEAT FAILURE					
Make:		Date Manufactured:	Model No./Name:		
Seat Type:		Installation System:			
Child Seat Component Code:		Failed Part:			
APPLICABLE INCIDENT INFORMATION <i>(Please describe in detail the incident(s), Failure(s), Crash(es), and injury (ies).)</i>					
Crash <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Fire <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Number of Persons Injured 2	Number of Deaths 1	Reported to Police Y	
<p>Narrative Description of Incident(S), Crash(es), and Injury (ies). Please describe (1) events leading up to the failure, (2) failure and its consequences, and (3) what was done to correct the failure; i.e. parts repaired or replaced (and if old part is available).</p> <p>ON SEPTEMBER 12, 2011, A KUMHO ROAD VENTURE AT TIRE, SIZE LT235/85R16, DOT K20RYD4A3508 (MANUFACTURED AT KUMHO'S BINH DUONG PLANT IN VIETNAM IN THE 35TH WEEK OF 2008) SUFFERED A CATASTROPHIC TREAD SEPARATION, RESULTING IN SEVERE INJURIES TO THE FRONT SEAT PASSENGER OF THE FORD F-250 AND THE DEATH OF HER SON, WHO WAS [REDACTED] OLD AND STILL IN UTERO.</p> <p>A LAWSUIT HAS BEEN FILED AGAINST KUMHO TIRE CO., INC. AND KUMHO TIRE U.S.A., INC. IN THE UNITED STATES DISTRICT COURT FOR THE DISTRICT OF KANSAS (CASE NO. [REDACTED]). DURING THE DISCOVERY STAGE OF THE CASE, THE PASSENGER RETAINED TROY COTTLES, A RENOWNED TIRE FAILURE EXPERT.</p> <p>AFTER INSPECTING THE SUBJECT TIRE, MR. COTTLES FOUND THE FOLLOWING DEFECTS IN THE SUBJECT TIRE: (1) INADEQUATE BONDING BETWEEN BELTS (TRAPPED AIR/STEAM BLISTER IMPRESSIONS); (2) PREMATURE OXIDATION OF THE BELT SKIMS; (3) BELTING DEFECTS (COINCIDENTAL BELT ENDINGS, IRREGULAR BELT WIRE SPACING, GAPPED BELT SPLICES, DOG-EARED SPLICES, SNAKING, AND SPREAD CABLES); (4) CORD SHADOWS ON THE INNERLINER; (5) LOW TOP BELT WIDTH TO TREAD WIDTH RATIO; AND (6) INADEQUATE APPLICATION O</p>					
Include, if available: Police/Fire Department Report, Photos, and Repair Invoice. ATTACH ADDITIONAL SHEETS IF NECESSARY					
The Privacy Act of 1974-Public Law 93-579 This information is requested pursuant to authority vested in the National Highway Traffic Safety Act and subsequent amendments. You are under no obligation to respond this questionnaire. Your response may be used to assist the NHTSA in determining whether a Manufacturer should take appropriate action to correct a safety defect. If the NHTSA proceeds with administrative enforcement or litigation against a manufacturer, your response, or a statistical summary thereof, may be used in support of the agency's action.					

AFTER INSPECTING THE SUBJECT TIRE, MR. COTTLES FOUND THE FOLLOWING DEFECTS IN THE SUBJECT TIRE: (1) INADEQUATE BONDING BETWEEN BELTS (TRAPPED AIR/STEAM BLISTER IMPRESSIONS); (2) PREMATURE OXIDATION OF THE BELT SKIMS; (3) BELTING DEFECTS (CONINCIDENTAL BELT ENDINGS, IRREGULAR BELT WIRE SPACING, GAPPED BELT SPLICES, DOG-EARED SPLICES, SNAKING, AND SPREAD CABLES); (4) CORD SHADOWS ON THE INNERLINER; (5) LOW TOP BELT WIDTH TO TREAD WIDTH RATIO; AND (6) INADEQUATE APPLICATION OF NYLON CAP PLYS.

AS PART OF HIS WORK ON THE CASE, MR. COTTLES TESTED TWO EXEMPLAR KUMHO ROAD VENTURE AT TIRES OF THE SAME SIZE AS THE SUBJECT TIRE THAT WERE ALSO MANUFACTURED AT KUMHO'S VIETNAM PLANT. BOTH OF THOSE TIRES FAILED IN SIDEWALL FAILURE MODE IN APPROXIMATELY 10,000 MILES OR LESS UNDER PROPER LOADS, INFLATIONS, AND SPEEDS THAT WERE MONITORED DAILY. **SEE TEST REPORTS AND PHOTOGRAPHS THAT WERE MAILED TO THE OFFICE OF DEFECTS INVESTIGATION ON JUNE 17, 2015.**

THIS INFORMATION IS BEING SUBMITTED BY THE ATTORNEYS FOR THE INJURED PASSENGER, AND WITH HER PERMISSION, IN HOPES THAT THIS TIRE (AND THOSE SIMILAR TO IT) WILL BE INVESTIGATED AND RECALLED TO ENSURE NO ONE ELSE IS NEEDLESSLY INJURED OR KILLED AS A RESULT OF THESE DANGEROUS AND DEFECTIVE TIRES.

June 17, 2015

U.S. Department of Transportation
National Highway Traffic Safety Administration
Office of Defects Investigation (NVF-210)
1200 New Jersey Ave SE
West Building
Washington, D.C. 20590

RE: ODI Number 10725608
Kumho Road Venture AT Tires (LT235/85R16)

To Whom It May Concern:

Our firm filed a safety complaint regarding Kumho Road Venture AT Tires (LT235/85R16) on June 16, 2015. Enclosed please find a CD containing the test reports and photographs referenced in our complaint. The tire testing was conducted by the expert we retained during our litigation of [REDACTED] v. *Kumho Tire Co., Inc., et al.* (Case No. [REDACTED] [REDACTED]), which is pending in the United States District Court for the District of Kansas.

Please let me know if you have any questions or would like any additional information. We are looking forward to hearing from you regarding our complaint.

Yours very truly,

KUHLMAN & [REDACTED] LLC

/s/ Lara M. Guscott

Lara M. Guscott

LMG
Encls.

From: [Abbew, Margaret CTR \(NHTSA\)](#)
To: [Fogle, Brenda CTR \(NHTSA\)](#)
Subject: FW: Complaint # 10725608
Date: Monday, July 27, 2015 6:54:17 AM
Attachments: [Kansas Motor Vehicle Accident Report - Full Report \[REDACTED\] BFFA6\).pdf](#)
[150617.NHTSA \[REDACTED\] BFFA6\).docx](#)
[NHTSA - Cottles Report \(Redacted\) \[REDACTED\] BFFA6\).pdf](#)
[NHTSA - Police Photos \[REDACTED\] BFFA6\).pdf](#)
[NHTSA - VOQ \[REDACTED\].pdf](#)

)
Sent: Thursday, July 23, 2015 3:39 PM

Subject: FW: Complaint # 10725608

From: Lara Guscott [<mailto:Lara@kuhlmanlucas.com>]
Sent: Thursday, July 23, 2015 11:31 AM
To: DataQuality, DataQuality (NHTSA)
Subject: VOQ: Complaint # 10725608

Office of Defects Investigation:

Attached please find the following materials:

- (1) Completed VOQ;
- (2) Police report;
- (3) Police photographs; and
- (4) Expert report regarding the defective tire.

Additionally, we submitted exemplar tire test data and photographs to your D.C. office on June 17, 2015 (attached is a copy of the letter). Please let us know if those materials have been added to our complaint.

Thanks,

Lara Guscott
Associate
Kuhlman & Lucas, LLC
1100 Main Street, Suite 2550
Kansas City, Missouri 64105
Telephone: [REDACTED]
Facsimile: (816) 799-0336
lara@kuhlmanlucas.com

NOTICE OF CONFIDENTIALITY, ATTORNEY-CLIENT PRIVILEGE AND/OR ATTORNEY WORK PRODUCT: The information contained in this e-mail message, including any attachments, is confidential information intended only for the use of the recipient(s) named above. The information is privileged and/or protected by the attorney-client privilege, the attorney work-product doctrine, or other similar privileges and limitations on disclosure. If you are not the named or intended recipient of this message, please do not read, rely upon, save, copy, print or retransmit, but rather, destroy it immediately and permanently delete the message from your computer or network system. Any unauthorized retransmission, retention, distribution, printing or copying of

this message or any attachments is strictly prohibited. If you have received this e-mail message in error, please immediately contact lara@kuhlmanlucas.com or call [REDACTED] immediately.
Thank you.

Kansas Motor Vehicle Accident Report

KDOT Form 850A Rev 1-2009

Investigating Department: **MISO** Reviewed by: **WAYNE MINCKLEY** Local Case No.: **0912261** Page of: **1 / 6**

Investigating Officer Name: **JOSEPH HORNER** Badge Number: **159** County: **MI** City Name: **LACYGNE**

- Amended Report
- DUI
- Hit & Run
- F** Accident Severity
 - Fatal Injury
 - PDO >= \$1,000
 - PDO < \$1,000
 - Private Property

Filepost: **107** Block No: _____ Dir Pfx: _____ On Road Name: **69** Road Type: **HWY** Dir Sfx: _____ SpdLmt: **75** Date of Accident (mm/dd/yyyy): **09/12/2011** Time Occur: **16:05** Day: **Mon**

From Dist: **.9** Ft/Mi: **MI** From Dir: **N** FROM: FROM AT Dir Pfx: **W** Reference or At Road Name: **399TH** Road Type: **ST** Dir Sfx: _____ SpdLmt: **55** Date Notified (mm/dd/yyyy): **09/12/2011** Time Notif: **16:12** Day: **Mon**

Narrative: Describe each traffic unit's pre-crash movement and direction of travel
Vehicle was travelling northbound on HWY 69. Approximately .8 miles north of the intersection of W. 399th the vehicle had a blown tire on the front right side. this resulted in the vehicle leaving the roadway on the right shoulder and rolling over. The vehicle came to a rest on the frontage road east of HWY 69.

Date Arrived (mm/dd/yyyy): **09/12/2011** Time Arriv: **16:28** Day: **Mon**

Latitude (AOI): **00** WORK ZONE TYPE AT **00**

Longitude (AOI): _____

Photos by: **159**

KDOT: Object 1 Damaged & Nature of Damage (show in diagram) Owner Street Address Personal Phone
 FENCE - METAL FENCE _____ _____

Owner Last Name First Name Middle Name City State Zip Work Phone
KDOT, _____, **KS** _____

KDOT: Object 2 Damaged & Nature of Damage (show in diagram) Owner Street Address Personal Phone
 _____ _____

Owner Last Name First Name Middle Name City State Zip Work Phone
 _____, _____, _____

ONLY CHECK ONE BOX PER CATEGORY UNLESS SPECIFIED OTHERWISE

01 LIGHT CONDITIONS

01 Daylight 04 Dark: street lights on
 02 Dawn 05 Dark: no street lights
 03 Dusk 99 Unknown

00 ADVERSE WEATHER CONDITIONS

io adverse conditions

01 Rain, mist, drizzle
 02 Sleet, hail
 03 Snow
 04 Fog
 05 Smoke
 06 Strong wind
 07 Blowing dust, sand, etc.
 08 Freezing rain, mist, drizzle
 14 Rain & fog
 16 Rain & wind 88 Other: _____
 24 Sleet & fog _____
 36 Snow & wind 99 Unknown

01 ON SURFACE TYPE AT _____

01 Concrete
 02 Blacktop (Asphalt)
 03 Gravel 88 Other: _____
 04 Dirt _____
 05 Brick 99 Unknown

01 ON SURFACE CONDITIONS AT _____

01 Dry 88 Other: _____
 02 Wet _____
 03 Snow 99 Unknown
 04 Ice
 05 Mud/dirt/sand
 06 Debris (oil, etc.)
 07 Standing/ moving water
 08 Slush

21 ACC. LOCATION (of 1st Harmful Event)

ON ROADWAY: (within travel lanes)

11 Non-intersection
 12 Intersection +
 13 Intersection-related +
 14 Access to Parking lot/Drvwy
 15 Interchange Area +
 16 On Crossover
 17 Toll Plaza

OFF ROADWAY:

20 Shoulder
 21 Roadside (not shoulder)
 22 Median
 23 Parking lot or Rest area
 88 Other: _____
 99 Unknown

+INTERSECTION TYPE

01 Four-way intersection
 02 Five-way or more
 03 T - intersection
 04 Y - intersection
 05 L - intersection
 06 Roundabout (See Manual for Definitions)
 07 Traffic Circle
 08 Part of an interchange
 99 Unknown

ROAD SPECIAL FEATURES (up to 3)

00 None **1** **00** **2** **3**

01 Bridge _____
 02 Bridge Overhead _____
 03 Railroad Bridge _____
 04 RRRING _____
 05 Interchange _____
 06 Ramp _____
 99 Unknown

01 ACCIDENT CLASS (mark 1 box per side) **01**

1 1st Harmful Event Most Harmful Event

00 Other non-collision
 01 Overturned/Rollover
 COLLISION WITH:
 02 Pedestrian
 03 Motor vehicle in-transport*
 04 Legally Parked Vehicle
 05 Railway train
 06 Pedal cyclist
 07 Animal Type: _____
 08 Fixed object**
 09 Other object: _____
 99 Unknown

17 **FIXED OBJECT TYPE **13**

(mark 1 box per side if applicable)

1 1st Harmful Event Most Harmful Event

01 Bridge structure
 02 Bridge rail
 03 Crash cush./Impact attenuator
 04 Divider, median barrier
 05 Overhead sign support
 06 Utility devices: pole, meter, etc
 07 Other post or pole
 08 Building
 09 Guardrail
 10 Sign post
 11 Culvert
 12 Curb
 13 Fence/Gate
 14 Hydrant
 15 Barricade
 16 Mailbox
 17 Ditch
 18 Embankment
 19 Wall
 20 Tree
 21 RRRING fixtures
 88 Other: _____
 99 Unknown

- LOCATION IN WORK ZONE (AOI)
- 01 Before first warning sign
 02 Advance warning area
 03 Transition area
 04 Activity area
 05 Termination area 99 Unknown

- WORK ZONE CATEGORY
- 01 Lane closure
 02 Lane shift / crossover
 03 Work on shoulder / median
 04 Intermittent or moving vehicle
 88 Other: _____
 99 Unknown
- *COLLISION WITH VEHICLE (mark 1 box per side if applicable)
- 1** 1st Harmful Event Most Harmful Event
- 01 Head on
 02 Rear end
 03 Angle - side impact
 04 Sideswipe: opposite direction
 05 Sideswipe: Same direction
 06 Backed into
 88 Other: _____
 99 Unknown

TRAFFIC CONTROLS (On / At Road) O/A

00 None

01 Officer, flagger

02 Traffic signal

03 Stop sign

04 Flasher

05 Yield sign

06 RR gates / signal

07 RR crossing signs

08 No passing zone

09 Center/Edge lines

10 Warning signs

11 School zone signs

12 Parking lines

88 Other: _____

99 Unknown PLOOOO01

	Type Present OK/NP		
	1	2	3
0	0	09	OK
2	2	2	
3	3	3	
4	4	4	
5	5	5	

Accident Diagram

850A continued

SPECIAL EVENT

SPECIAL DATA

Local Case No.

Page of

2 / 6

04 ROADWAY NUMBER OF LANES AT

01 One
 02 Two
 03 Three
 04 Four to Six
 05 Seven or more
 88 Other: _____
 99 Unknown

01 ROAD CHARACTER ON AT

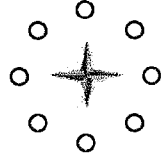
01 Straight & Level
 02 Straight on grade/slope
 03 Straight on hillcrest
 04 Curved & level
 05 Curved on grade/slope
 06 Curved on hillcrest
 88 Other: _____
 99 Unknown

00 SPECIAL JURISDICTION

00 Normal Jurisdiction (Not Special)
 01 National Park Service
 02 Military
 03 Indian Reservation
 04 College / University Campus
 05 Other Federal property
 88 Other: _____
 99 Unknown

A basic diagram is required for all state reportable accidents showing movements, direction, and positions of all traffic units in relationship to the trafficway. Identify (label) the street(s) and traffic unit(s) along with the area of impact (AOI) where possible. Refer to vehicles and pedestrians by unique numbers assigned in this report.

Indicate North Direction



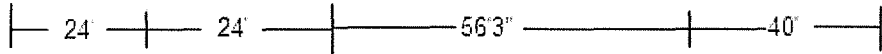
Draw scene as observed or recreate per statements and evidence available



Frontage Road
Gravel

Fence

Hwy 69
 NB Lanes
Cement



Note: The above line scale is 1"=20'; 5 feet squares. If another scale is used, please specify.

PL000002

TU#	VIOLATIONS CHARGED	CITATION#	TU#	VIOLATIONS CHARGED	CITATION#

OFFICER'S OPINION OF APPARENT CONTRIBUTING CIRCUMSTANCES - ENTER AS MANY AS APPLY TO THIS ACCIDENT (FACTOR TYPE, TU#, CC CODE)

v1 02

Unit #	DRIVER Last Name	Middle Name	DRIVER ADDRESS (Number, Street, Suffix, etc.)			Personal Phone Number	Gender	SE Used	Inj Severity	Transpt Unit
Seat Type	DRIVER First Name	Date of Birth	City	State	Zip	Work Phone Number	Age	Eject/Trap	Eject Path	Extraction?
TU 1	[REDACTED]	MN	[REDACTED]	[REDACTED]	[REDACTED]	Personal		F	S	N
ST 01	[REDACTED]	[REDACTED]	PAOLA	KS	[REDACTED]	Work			N	<input type="checkbox"/>
TU		MN				Personal				
ST		DOB				Work				<input type="checkbox"/>

TRAFFIC UNIT# 1 (01, 03, N3, X3, etc) **TRAFFIC UNIT# [REDACTED] (02, 04, N2, X4, etc)**

DL State	Driver's License Number	DL Class	Driving for Employer?	CDL?	DL State	Driver's License Number	DL Class	Driving for Employer?	CDL?
TX	[REDACTED]	C	<input type="checkbox"/>	<input type="checkbox"/>	[REDACTED]	[REDACTED]		<input type="checkbox"/>	<input type="checkbox"/>

01	DR LICENSE COMPLY	RESTRICT COMPLY	COMMERCIAL ENDORSEMENTS				DR LICENSE COMPLY	RESTRICT COMPLY	COMMERCIAL ENDORSEMENTS				
	00 Not licensed	Restrictions? <input checked="" type="checkbox"/> N	1 <input checked="" type="checkbox"/> Z	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	00 Not licensed	Restrictions? <input type="checkbox"/>	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	
	01 Valid License	Driver's Lic Restrictions <input type="checkbox"/> Y <input checked="" type="checkbox"/> N	Z - None					01 Valid License	Driver's Lic Restrictions <input type="checkbox"/> Y <input checked="" type="checkbox"/> N	Z - None			
	02 Suspended		T - Double/Triple Trailer					02 Suspended		T - Double/Triple Trailer			
	03 Revoked	1 <input type="checkbox"/>	P - Passenger Vehicle					03 Revoked	1 <input type="checkbox"/>	P - Passenger Vehicle			
	04 Expired	2 <input type="checkbox"/>	N - Tank Vehicle					04 Expired	2 <input type="checkbox"/>	N - Tank Vehicle			
	05 Cancl'd or Denied	3 <input type="checkbox"/>	H - Placarded Haz. Material					05 Cancl'd or Denied	3 <input type="checkbox"/>	H - Placarded Haz. Material			
	06 Disqualified	4 <input type="checkbox"/>	X - Combination Tank/HazMat					06 Disqualified	4 <input type="checkbox"/>	X - Combination Tank/HazMat			
	07 Restricted		S - School Bus					07 Restricted		S - School Bus			
	99 Unknown		U - Unknown					99 Unknown		U - Unknown			

SUBSTANCE USE (mark all that apply)				SUBSTANCE USE (mark all that apply)			
<input type="checkbox"/> AP - Alcohol ingested	<input type="checkbox"/> DC - Illegal drugs contributed	<input type="checkbox"/> AC - Alcohol contributed	<input type="checkbox"/> MP - Medication ingested	<input type="checkbox"/> AP - Alcohol ingested	<input type="checkbox"/> DC - Illegal drugs contributed	<input type="checkbox"/> AC - Alcohol contributed	<input type="checkbox"/> MP - Medication ingested
<input type="checkbox"/> DP - Illegal drugs ingested	<input type="checkbox"/> MC - Medication contributed			<input type="checkbox"/> DP - Illegal drugs ingested	<input type="checkbox"/> MC - Medication contributed		

METHOD OF DETERMINATION (mark all that apply)		IMPAIRMENT TEST (mark all that apply)		METHOD OF DETERMINATION (mark all that apply)		IMPAIRMENT TEST (mark all that apply)	
<input checked="" type="checkbox"/> 00 No evidence of impairment	<input checked="" type="checkbox"/> DRUGS	<input checked="" type="checkbox"/> NG - No Test given		<input type="checkbox"/> 00 No evidence of impairment	<input type="checkbox"/> DRUGS	<input type="checkbox"/> NG - No Test given	
<input type="checkbox"/> 01 Evidential Test (Breath, Blood, etc)	<input type="checkbox"/>	<input type="checkbox"/> TR - Test Refused (Alcohol/Drug)		<input type="checkbox"/> 01 Evidential Test (Breath, Blood, etc)	<input type="checkbox"/>	<input type="checkbox"/> TR - Test Refused (Alcohol/Drug)	
<input type="checkbox"/> 02 Preliminary Breath Test PBT	<input type="checkbox"/>	<input type="checkbox"/> PT - Prelim Positive Test (PBT)		<input type="checkbox"/> 02 Preliminary Breath Test PBT	<input type="checkbox"/>	<input type="checkbox"/> PT - Prelim Positive Test (PBT)	
<input type="checkbox"/> 03 Behavioral	<input type="checkbox"/>	<input type="checkbox"/> TG - Evidentiary Test given		<input type="checkbox"/> 03 Behavioral	<input type="checkbox"/>	<input type="checkbox"/> TG - Evidentiary Test given	
Tests: HGN, walk-and-turn, one leg stand, etc.		<input type="checkbox"/> RP - Results pending		Tests: HGN, walk-and-turn, one leg stand, etc.		<input type="checkbox"/> RP - Results pending	
<input type="checkbox"/> 04 Passive Alcohol Sensor (detects alcohol from driver's mouth)	<input type="checkbox"/>	<input type="checkbox"/> Evidentiary Breath	<input type="checkbox"/> Eye Fluid	<input type="checkbox"/> 04 Passive Alcohol Sensor (detects alcohol from driver's mouth)	<input type="checkbox"/>	<input type="checkbox"/> Evidentiary Breath	<input type="checkbox"/> Eye Fluid
<input type="checkbox"/> 05 Observed (Odor, staggering, slurred speech, etc)	<input type="checkbox"/>	0. _____	0. _____	<input type="checkbox"/> 05 Observed (Odor, staggering, slurred speech, etc)	<input type="checkbox"/>	0. _____	0. _____
<input type="checkbox"/> 06 Other (e.g. saliva test)	<input type="checkbox"/>	<input type="checkbox"/> Blood (BAC)	<input type="checkbox"/> Other	<input type="checkbox"/> 06 Other (e.g. saliva test)	<input type="checkbox"/>	<input type="checkbox"/> Blood (BAC)	<input type="checkbox"/> Other
		0. _____	0. _____			0. _____	0. _____
		Drug screen result <input type="checkbox"/>				Drug screen result <input type="checkbox"/>	

Unit #	PASSENGER Last Name	Middle Name	PASSENGER ADDRESS (Number, Street, Sfx, etc.)			Personal Phone Number	Gender	SE Used	Inj Severity	Transpt Unit
Seat Type	PASSENGER First Name	Date of Birth	City	State	Zip	Work Phone Number	Age	Eject/Trap	Eject Path	Extraction?
TU 1	[REDACTED]	MN	[REDACTED]	[REDACTED]	[REDACTED]	Personal		F	N	P
ST 03	[REDACTED]	DOB	GARDEN CITY	MO	[REDACTED]	Work			E	99
TU		MN				Personal				
ST		DOB				Work				<input type="checkbox"/>
TU		MN				Personal				
ST		DOB				Work				<input type="checkbox"/>
T		MN				Personal				
ST		DOB				Work				<input type="checkbox"/>

Transport Unit	EMS Time Notified	Injured taken by:	Transport Unit	EMS Time Notified	Injured taken by:
		LIFE FLIGHT			
EMS Arrived	EMS Time@Hosp	Injured taken to:	EMS Arrived	EMS Time@Hosp	Injured taken to:
		TAKEN TO OPR			PL000003

Occupants & Vehicles
850B Continued

VEHICLE# 1
(01, 03, N3, X3, etc)

SPECIAL DATA

VEHICLE#
(02, 04, N2, X4, etc)

SPECIAL DATA

Local Case No.

Page of
4 / 6

OWNER Last Name ("Same" if Driver) OWNER First Name Middle Name
OWNER ADDRESS (Number, Street) New address? Personal Phone
PAOLA ST KS ZIP Work Phone
COLOR YEAR MAKE MODEL BODY STYLE ST
RED 2001 FORD F250 PK KS
LICENSE PLATE # County Exp YR Removed by: MC CCs
DIR of Travel # Occupants
3FTNF21F01M NN 2

OWNER Last Name ("Same" if Driver) OWNER First Name Middle Name
OWNER ADDRESS (Number, Street) New address? Personal Phone
CITY ST ZIP Work Phone
COLOR YEAR MAKE MODEL BODY STYLE ST
LICENSE PLATE # County Exp YR Removed by: MC CCs
VEHICLE IDENTIFICATION NUMBER DIR of Travel # Occupants

Insurance Company Policy Number
KANSAS STATE FARM

Insurance Company Policy Number

SPECIAL CONDITIONS FOR TRAFFIC UNITS 1 7 2 3 4 5 Odometer 42498 Fire?
1 Hit & Run 2 Non-Contact 3 Stolen 7 Towed away due to damage
4 Legally Parked 5 Pursued by LE 6 Driverless

SPECIAL CONDITIONS FOR TRAFFIC UNITS 1 2 3 4 5 Odometer Fire?
1 Hit & Run 2 Non-Contact 3 Stolen 7 Towed away due to damage
4 Legally Parked 5 Pursued by LE 6 Driverless

05 VEHICLE BODY TYPE LARGE / HEAVY VEHICLE (GCVWR over 10,000lbs)
01 Automobile 10 Single heavy truck >10,000 lbs
02 Motorcycle 11 Truck & trailer(s)
03 Motor scooter or Moped 12 Tractor-trailer(s) Calculated speed at impact 75
04 Van 13 Cross country bus
05 Pickup truck <10,001 lbs 14 School bus Bus Seat Capacity
06 Sport utility veh - SUV 15 Transit (city) bus
07 Camper or RV 16 Other bus Power Source F
08 Farm machinery 25 Train
09 All-terrain vehicle - ATV 88 Other: 99 Unknown

VEHICLE BODY TYPE LARGE / HEAVY VEHICLE (GCVWR over 10,000lbs)
01 Automobile 10 Single heavy truck >10,000 lbs
02 Motorcycle 11 Truck & trailer(s)
03 Motor scooter or Moped 12 Tractor-trailer(s) Calculated speed at impact
04 Van 13 Cross country bus
05 Pickup truck <10,001 lbs 14 School bus Bus Seat Capacity
06 Sport utility veh - SUV 15 Transit (city) bus
07 Camper or RV 16 Other bus Power Source
08 Farm machinery 25 Train
09 All-terrain vehicle - ATV 88 Other: 99 Unknown

01 VEHICLE USE
01 No special use 06 Police
02 Taxi / Limo 07 Ambulance
03 School bus 08 Fire
04 Other bus 09 Mail/Parcel
05 Military 99 Unknown

03 VEHICLE DAMAGE
00 None 04 Destroyed
01 Damage (minor) 88 Other:
02 Functional
03 Disabling 99 Unknown

VEHICLE USE
01 No special use 06 Police
02 Taxi / Limo 07 Ambulance
03 School bus 08 Fire
04 Other bus 09 Mail/Parcel
05 Military 99 Unknown

VEHICLE DAMAGE
00 None 04 Destroyed
01 Damage (minor) 88 Other:
02 Functional
03 Disabling 99 Unknown

DAMAGE LOCATION AREA
First Impact 2 Major Impact 2
14 Undercarriage 15 Windshield
16 Other windows 99 Unknown
17 Entire vehicle damaged
88 Other:
Trailer: Present / Damaged

01 VEH. MANU. BEFORE UNSTAB. SIT.
01 Straight/ following road 11 Stopped awaiting turn
02 Left Turn 12 Stopped in traf
03 Right Turn 13 Illegally parked
04 U Turn 14 Disabled in roadway
05 Passing 15 Slowing or stopping
06 Changing lanes 16 Negotiating a curve
07 Avoidance man. 88 Other:
08 Merging
09 Parking
10 Backing 99 Unknown

DAMAGE LOCATION AREA
First Impact Major Impact
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VEHICLE SEQUENCE OF EVENTS (List up to 4 per unit in the order of occurrence)
1 01 2 04 3 4 The exact sequence is unknown

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1 2 3 4 The exact sequence is unknown

NON-COLLISION
01 Ran off road right 10 Downhill runaway
02 Ran off road left 11 Trailer swing
03 Crossed centerline 12 Separation of units
04 Overturn/Rollover 13 Jackknife
05 Crossed median 14 Fire
06 Fell/Jumped from veh 15 Explosion
07 Thrown or falling object 16 Immersion in water
08 Cargo loss or shift 88 Other event:
09 Equipment failure (tire, brakes, etc.) 98 Unknown non-coll.

COLLISION WITH
21 Pedestrian
22 Motor veh in-transport
23 Legally Parked Vehicle
24 Train
25 Pedal cycle (bike, etc)
26 Animal
27 Fixed Object
28 Other moveable object
99 Unknown object

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01 Ran off road right 10 Downhill runaway
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23 Legally Parked Vehicle
24 Train
25 Pedal cycle (bike, etc)
26 Animal
27 Fixed Object
28 Other moveable object
99 Unknown object

MAIN NARRATIVE

On 09/12/2011 at approximately 1612 hours, a call of service was dispatched regarding a single vehicle rollover that had resulted in injuries to one of the occupants. The accident occurred in the area of W. 399th St. and 69 Hwy in Miami County, Kansas. It was described as the vehicle was on the northbound side of the highway.

I arrived at the scene which was located .9 miles north of W. 399th St. on 69 Hwy. It appeared that the vehicle had a blowout on the front right tire of the vehicle while traveling northbound on 69 Hwy. There were obvious markings left by the vehicle that were measured at approximately 101' and 128' before that vehicle apparently left the roadway on the right shoulder. The markings left by the tires displayed that the vehicle traveled for a short distance before the tires struck a ditch resulting in the vehicle rolling over. The vehicle rolled and came to a rest on its tires on the roadway located to the east of 69 Hwy. The roadway is a frontage road to 69 Hwy that connects W.399th Street and W.391st Street. There was obvious significant damage to the vehicle.

Photographs of the scene were taken as well as measurements to document the travel of the vehicle before coming to a rest. The passenger [REDACTED], was being treated upon my arrival by EMS and was soon flown by helicopter for further treatment. I was later informed that the passenger was approximately 8 months pregnant and apparently had been ejected from the vehicle during the accident. The driver, [REDACTED], of the vehicle had no apparent injuries at the time of her interview.

The owner of the vehicle, [REDACTED], arrived at the scene a short time after deputies had arrived. He was asked if he had a preference of who removed the vehicle. He asked that Cutshaw towing be contacted for the removal of the vehicle. I stayed on scene until the arrival of Cutshaw towing service arrived and stood by until the wrecker driver took possession of the vehicle.

Nothing further to report at this time.

Deputy Joe Horner.

SUPPLEMENTAL NARRATIVE - ASSIST 159

OFFICER: 161

9/12/2011

On September 12, 2011 at 1612 hrs, I assisted Deputy Horner on an injury accident at 69 Highway just north of W. 399th Street. When I arrived on scene, EMS was on scene dealing with a female that was on the ground. She was a white female that was injured from the vehicle that was the passenger. She was pregnant also.

I made contact with the driver of the vehicle identified as [REDACTED]. [REDACTED] advised me that she was driving the Ford F-250 pick up that was northbound on 69 Highway. [REDACTED] said that she was going 75 mph. [REDACTED] said the front right tire blew out and she went into the ditch. [REDACTED] said the vehicle rolled but she was unaware of how many times it rolled.

[REDACTED] said the passenger identified as [REDACTED] was not wearing her seat belt and was thrown out of the vehicle. [REDACTED] said that [REDACTED] normally wears her seat belt but did not have it on at the time. [REDACTED] told me that [REDACTED] was 8 months pregnant.

[REDACTED] said that she was wearing her seat belt and was not injured. Life Flight was on scene and transported [REDACTED] to Overland Park Regional [REDACTED] was checked by EMS and released on scene. I had [REDACTED] fill out a statement form.

I assisted Deputy Horner on diagram of the scene and Cutshaw was the next available tow for the owner of the vehicle. After the scene was cleared, I cleared the call.

End of Narrative.

Deputy Juan A. Arriola

SUPPLEMENTAL NARRATIVE - FOLLOW-UP WITH MEGAN PENNY

OFFICER: 159

9/13/2011

On 09/13/2011 at approximately 1630 hours, I attempted to make contact with [REDACTED] by telephone. The call was in reference to the possible fatality of her unborn child as a result of the wreck that had occurred.

No contact was made. I will attempt at a later time on 09/13/2011.

Nothing further to report at this time.

Deputy Joe Horner

SUPPLEMENTAL NARRATIVE - CONTACT MADE WITH OVERLAND PARK HOSPITAL

OFFICER: 159

PL000005

9/13/2011

On 09/13/2011 at approximately 2110 hours, I was able to make contact with Crystal Brawley R.N. who is employed by Overland Park Hospital. I was advised by Crystal that there were substantial injuries to [REDACTED] as a result of the accident. I had attempted contact with [REDACTED] however due to the injuries the resulted from the wreck, she was unable to discuss the incident with me.

Crystal was able to advise me that the unborn child was deceased due to injuries from the accident. She advised of extent of the injuries that [REDACTED] was suffering from included lacerations on her spleen, occipital bone fractures, and lower spinal injuries. She advised that the injuries did not appear to be life threatening at this time.

End of report,
Deputy Joe Horner

SUPPLEMENTAL NARRATIVE - SUPPLEMENT REPORT

OFFICER: 902

9/16/2011

On Friday, 09162011 at approximately 1530 hours, I, (Sgt. John Williams), received a telephone call from Rita Stanchfield who works at Dr. Banks Office. Stanchfield said that she needed a copy of the accident report for the autopsy proceedings on [REDACTED] unborn child. Stanchfield said that the unborn child had lived for approximately 4 hours at Overland Park Regional. Stanchfield advised me that the child is currently at First Call and scheduled for an autopsy on 09172011 at 1030 hours to rule cause of death. Stanchfield had nothing further.

I faxed Stanchfield the first 4 pages of the accident report right after the phone conversation.

I have nothing further to report.

Accident Diagram
850A continued

SPECIAL EVENT

SPECIAL DATA

- ROADWAY NUMBER OF LANES**
- Q/A
- 01 One
 - 02 Two
 - 03 Three
 - 04 Four to Six
 - 05 Seven or more
 - 88 Other: _____
 - 99 Unknown

- ROAD CHARACTER**
- Q/A
- 01 Straight & Level
 - 02 Straight on grade/slope
 - 03 Straight on hillcrest
 - 04 Curved & level
 - 05 Curved on grade/slope
 - 08 Curved on hillcrest
 - 88 Other: _____
 - 99 Unknown

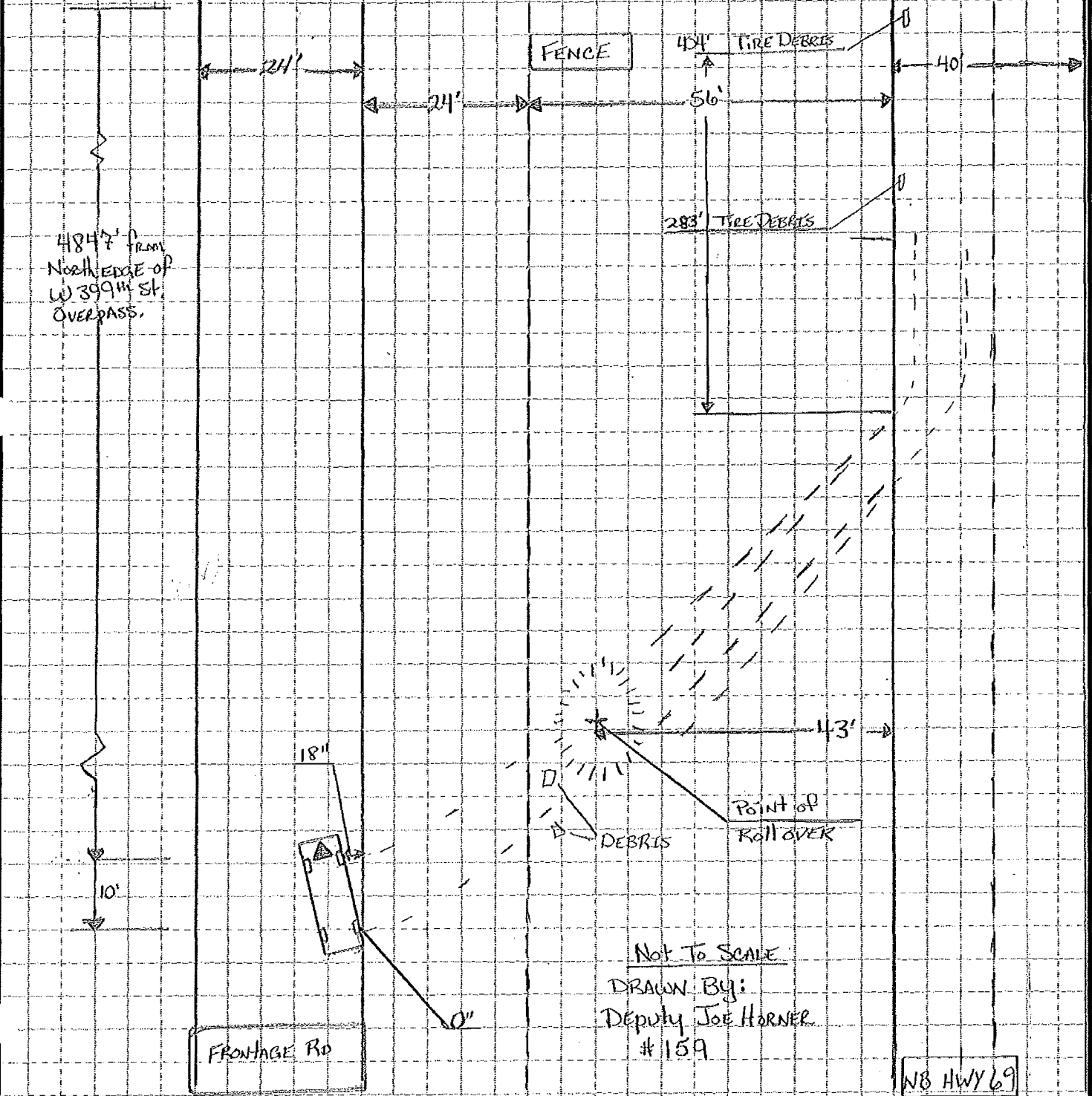
- SPECIAL JURISDICTION**
- 00 Normal Jurisdiction (Not Special)
 - 01 National Park Service
 - 02 Military
 - 03 Indian Reservation
 - 04 College / University Campus
 - 05 Other Federal property
 - 88 Other: _____
 - 99 Unknown

A basic diagram is required for all state reportable accidents showing movements, direction, and positions of all traffic units in relationship to the trafficway. Identify (label) the street(s) and traffic unit(s) along with the area of impact (AOI) where possible. Refer to vehicles and pedestrians by unique numbers assigned in this report.

Indicate North Direction



Draw scene as observed or recreate per statements and evidence available



Note: The above line scale is 1" = 20' 1/2 feet squares. If another scale is used, please specify.

Not to Scale

MIAMI COUNTY SHERIFF'S OFFICE
118 SOUTH PEARL
PAOLA, KS 66071

Date: 9/12/11 Page #: Case #: [Redacted]

Statement of [Redacted]

Last Name	First Name	MI	Date of Birth
[Redacted]	Paola		KS
Address		City	State

Daytime Telephone: [Redacted] Night Time Telephone: ""

I was driving north on 169 hwy
at approx 3:15 pm. We were going
75 mph in the slow lane. Right
front tire blew out. The truck
rolled. I was wearing my seat
belt. [Redacted] was thrown from the
vehicle.

[Signature] # 101
Deputy/Witness ID#

[Redacted Signature]

Revised August 2000

SUPPLEMENTAL
TIRE FAILURE ANALYSIS REPORT

In the case of:

[REDACTED] **v. Kumho**

Introduction

Passenger & Light Truck Tire Manufacturing Process

Passenger & Light Truck Tire Design

Examination and Findings

History

Materials Reviewed

Analysis

Summary

C.V.

Fee Schedule

Publications

Deposition Testimony History

References

Appendix

Prepared:

Prepared for:

Troy Cottles
25884 Katpaugh Lane
Toney, AL 35773

[REDACTED]

INTRODUCTION

I am by training and experience a tire failure analysis and tire design expert. I have been employed in the tire industry for 17 years with Dunlop Tire Corporation (later Goodyear-Dunlop Tires North America, Ltd.), designing, manufacturing, and testing steel belted radial tires and others. I have also examined numerous tires that have been involved in tread separation accidents since leaving my employment in the tire industry. My C.V. is attached.

THE TIRE MANUFACTURING PROCESS (passenger and light truck)

The raw materials required to produce a steel-belted radial tire include both synthetic and natural rubber types. In all, a single tire may have more than thirty five different processed component parts.

The tire will include chemicals to assist in the bonding of one component to another, to reduce the effects of oxygen and ozone degradation, to accelerate and activate chemical bonds and molecular cross-linking of polymers and fillers and salts, and to improve the process-ability of the rubber compounds through the Banbury mixing process, rubber mills, and extruders.

Ingredients called fillers are the building blocks of the rubber formulas. These include clays, carbon blacks, zinc oxides, silica, and others. They each provide strength to the rubber formulation, as well as other properties.

The Banbury is a giant blender which mixes rubber in large batches. Operators use a batch recipe for a specific rubber formulation type and add the proper number of bales of natural rubber, synthetic rubber, aromatic or naphthenic oils, wax, sulfur, and other curatives onto a weigh station conveyor which is fed into the Banbury. Loose items like carbon black or silica are conveyed in from outside silos to reduce the environmental impact of handling the dusts. Within the Banbury, high heat and pressure are applied to the batch.

The rubber batch is removed hot from the Banbury, but as it cools, it is processed as slabs of rough rubber stock.

The slab stock is further processed on breakdown mills, which masticate the rubber between pairs of rollers continuously until the compound can be properly worked onto another mill type called a feed mill. The feed mill prepares the milled stock to be fed through an extruder die to become components such as tread or sidewall stock.

Other rubber types are used for skim on fabrics used in the tire, such as polyester, nylon, and rayon. These could be nylons used as cap plies, body plies, bead bundle wraps or flippers, sidewall inserts, or chafers. In today's radial passenger tires, polyester and rayon are more highly utilized as body ply fabrics than nylon. The processing of rayon is not as environmentally friendly as polyester, but continues to be used heavily in the European market. Though some rayon is used as ply material in North American produced tires, the expansion is in polyester. Still other rubber formulations are used as skims on the steel belts.

After all calendered fabrics, extrudants, and calendered rubber are processed, the tire can be assembled.

Bead

Once the correct links are inserted on the bead winder to hold the desired inside bead diameter, the specified bead configuration can be produced. The strands of wire are run through a cold-feed extruder to coat the wires in a layer of rubber. Whether by a taped bead assembly (turns and strands) or by a single wound bead (hexagonal or polygonal), the final bead assembly is a hoop of layered steel wires embedded in rubber.

Some manufacturers staple the loose end to the rest of the bundle. Some spiral a nylon thread around the splice point at the last wire end. Some wrap the entire wire bundle length in a coated nylon wrap. While some have increased the tack properties of the rubber coat sufficiently to keep the last turn of wire(s) from lifting off the hoop during tire building and curing.

The next process might be the application of a bead apex to the bead bundle. With a bead bundle width of four, five, six, or seven strands wide, a natural void occurs above the bead due to the difficulty of getting the plies to conform around the square or polygonal shape of the bead. To remedy this, a rubber filler (apex) is installed atop the bead bundle. Dimensionally, these can range from as small as one half inch in height to several inches tall. Of course, the smaller the apex, the less performance it actually contributes in its ability to stiffen the lower sidewall and damp inputs, as discussed later under the tire design heading.

To countermeasure against the apex separating from the bead bundle in tire building, curing, or in-field service, some manufacturers utilize a coated nylon “flipper” material to wrap the bead bundle and adhere to the apex, reducing the likelihood of damage due to the handling involved in the tire manufacturing process, when the components are still “green” and not chemically bonded to each other during the curing of the tire.

At the tire building machine two bead assemblies (bead and apex), would be set in retainers outside the main tire building drum. These are held in place until after the innerliner and plies are assembled, then the beads are drawn in to the sides of the drum above the edges of the innerliner and plies. At this point the innerliner and ply edges would be folded over the bead (creating the ply turn ups for the green tire and locking the beads into position).

Innerliner

To eliminate the inner tube in radial tires, the innerliner was developed to sustain inflation pressure in the tire and be a rubber veneer cured directly to the plies. In the early 1980s, the innerliner was for many manufacturers purely a natural rubber component—the result being unfavorable long-term air retention. In the worst cases, new tires mounted on OE vehicles would be flat again before the vehicle left the shipping lot outside the vehicle manufacturer’s property.

Clearly, synthetic chemical agents were required to assist the air retention properties. Halobutyls have since been used in higher and higher concentrations to improve resistance to air permeation. Chloro-butyls and bromo-butyls are popularly utilized in many of today’s radial passenger and light truck tires.

The innerliner is prepared as a flat sheet. Some manufacturers may produce innerliner as a single pass material with a specified gauge. Others prepare it in two passes of nearly equal gauge resulting in the final specified gauge. While yet others differ the chemical composition of the two layers—one a natural rubber barrier and the other a butyl layer.

The innerliner is supplied to the building machine in a roll of fabric or vinyl liner. It is pulled through the servicing trays on a building machine and applied in one or more rotations around an expanded drum. Some tire makers would consolidate a chafer material (fabric or gum) to the ends of the innerliner width, in order to place this material in proper position to protect the tire from excessive rim chafing in use.

At the building machine, the first component to be applied to the drum is the innerliner. Once the innerliner is applied to the drum and the drum is rotated one revolution (two if the innerliner gauge is processed at half gauge to eliminate a set up change in the area of innerliner manufacture), special care has to be taken with the innerliner to ensure the splice is properly sealed.

In the green state, the only seal of the splice is the tack level the innerliner has to itself, which should be assisted by roller stitching the splice location. If this is not properly done, the splice may open later to allow a conduit for oxidative attack on the internal components of the tire, resulting in chemical aging and degradation.

Also, if the splice is too blunt (lacking a skive angle), it creates a dam for trapped air during the curing process. This also can gather at the splice location to create an opportunity for air infiltration throughout the tire's use.

Plies

The body plies of the tire are also delivered to the tire building machine in a liner roll. In a two-ply tire, the plies are typically cut at a different width from each other. Care must be given to maintaining a minimum distance between the turn up heights of each ply (or any other component) so as not to create coincidental endings of materials. These act as hinge points during the flexing of the tire's sidewall region.

Establishing the first ply as the wider ply allows for the outer ply turn-up to protect all internal fabric endings beneath. This technique is not necessarily universally applied by the different tire manufacturers, however. Both plies typically are wider than the innerliner widths in a 2-0 construction.

When speaking of "radial" tires, we are speaking of the direction of the body plies in relation to the direction of travel. One convention of identifying the angle of radial tires is to specify the plies as being at 90 degrees within the tire.

The plies are applied over the innerliner on the building drum, (rotated) and spliced to ensure the plies do not "pop open" during the rest of the building sequence or at the time of curing. An inadequate splice will result in tire failure along the ply splice.

Sidewalls

The sidewalls which have been extruded through single, dual, triple, or quadruple head extruders are delivered to the building machine in rolls. These might be supplied to the building machine in separate rolls.

The use of a single-head extruder would imply the entire sidewall consisted of only one rubber compound. In a typical case, a sidewall formed through a dual extruder head may have a sidewall compound and a rim protector compound in the lower sidewall region. A triple extrusion might consist of a separate compound to be positioned under the belt edges as a belt cushion, a sidewall compound, and a rim protector compound. An example of a quadruple-head extruder would be the same as the three head extrusion, with perhaps a white sidewall compound included for the raised lettering or stripe in the tire.

Once the plies have been turned over the bead, the next component to be assembled is the sidewall. The drum is again rotated and the sidewalls are cut on a skive angle by a heated knife and the splice is stitched. After this step, automatic stitchers on the building machine may be used to increase the green tack among all components, while removing as much trapped air as possible between layers.

The resulting assembly resembles a rubber tube or sleeve. In the next stage the tire will be shaped more closely to the appearance of a final cured tire.

This completes what is termed the “first stage” building process. From here, the first stage body carcass is transferred to the second stage machine, unless a single-stage building machine is being utilized, where the same drum is used to complete all assembly.

At the second stage machine, the steel belts, nylon cap plies, and tread piece are applied onto a drum which is set to a larger diameter, in order to be later transferred onto the inflated first stage carcass.

Steel Belts

There are basically two methods in use to prepare a standard steel belt. The older method entails processing a roll of calendered steel and cutting six to nine inch pieces of the belt on a given bias angle. These individual strips are then zipper-stitched together to create a longer roll of belt material at the desired sheet width and belt angle to be used for a specific tire.

Prior to rolling up the stitched belt segments, a belt edge gumstrip or belt wedge component might be included on the first belt to consolidate tasks.

A length of this belt material adequate to cover the circumference of a tire might have six to nine wire splice locations. Some of the shortcomings of this technique are:

- Poor guide control on the zipper-stitcher operation allows for “floating” of the individual belt pieces along the conveyor. This creates irregular belt edge endings from one piece to the other. In the finished tire, these create opportunities for wires in the same belt to come into contact with each other during flexion. Obviously, this creates some level of “snaking” between belts, which can result in belt to belt contact.
- Multiple cut lengths of wire in each belt segment results in multiple wires per tire having inadequate rubber skim coverage.
- Multiple wire overlaps due to the splicing of those six to nine belt splices per belt means one or more wires in each segment per belt can have wire to wire contact, which eventually wears through any available belt skim in loaded tire operation.
- Shelf life is an issue with this technique because the time it takes to produce a belt length for even one tire is lengthened as compared to more recent methods. This involves the belt remaining in the roll or liner longer than other components, which in many cases results in liner pattern marks on the belt skim, which impede proper bonding to the next belt’s skim during tire curing, resulting in imminent belt separation.
- Humidity-controlled environment also is an issue, because many times this equipment was not installed within the temperature and humidity controlled portions of the manufacturing facility resulting in early sulfur bloom of the belt skim stock and moisture attack on the exposed steel wires, both of which are known to result in a failure to create a properly bonded belt system in the tire.
- Wire spacing within a Steelastic belt is often inconsistently spaced. These irregularly spaced wires ultimately result in large enough voids between belts to require the available skim to flow into the voids during the curing process. The flow of skim into open splices or irregular wire spacings creates a reduction in the available skim gauge in those specific areas, which has generated unnecessary heat within the belt systems causing belt to belt separations in tires.

Another technique for preparing steel belts which has been available to the industry since at least the late-1980s, is the use of larger creel calenders to uniformly space the belt wires and to handle the wires in a temperature and humidity-controlled area. The creeled wires are fed through a combset (approximately four to six feet wide) to a mill where the skim is embedded into and onto the wires. This is rolled and delivered to a shear cutter which has been set to the desired belt angle. The belt is cut to width on the proper angle. Normally one cut is sufficient for the circumference of a tire of smaller overall diameter.

This method produces a uniform belt edge position for the entire cut. It involves only a single splice in the first belt and a single splice in the second belt. The belt edge gumstrip or belt wedge can also be consolidated on the rollup of the cut belts in the liner. Belt cuts for multiple tires can be achieved in the same time it takes to assemble several belt segments into a single tire belt on the Steelastic-type equipment, so that not only is their efficiency in the operation, but the belt material is not exposed to environmental effects any longer than necessary.

On the second stage drum, the first belt (perhaps with belt wedges) is applied first. The drum is rotated and the belt is cut with a hot knife along the path of the steel cords. The ends are butt-spliced together.

The second belt is now applied centrally over the first, rotated, and spliced the same as the first belt. In order to ensure proper positioning of the steel belts, a guidance system is normally applied to reduce variation in component placement. Such a guidance system may consist of automated component placement, laser lights to spot proper drum locations for components, etc. in order to maintain consistency between constructive features in the tire.

Nylon Cap Ply/Edge Bands

By whatever means used (jointless nylon band or full belt widths of nylon), the next component to be applied is the nylon cap ply and or nylon edge bands.

If using full widths, the material is supplied on a servicing tray on the backside of the second stage building machine drum. If nylon band strips are being used, the applicator head might be behind the operator near the tread servicer. By attaching a strip to the edge of the first belt on the building drum and using multiple drum rotations to tension the nylon as it winds on, the applicator head either steps across to cover the steel belts in increments or moves on a screw so that the spiraling continues, according to the patented techniques being utilized by a particular tire manufacturer.

Tread

Once the belts and/or nylon is applied, the last component to be assembled is the tread. Typically, rather than rolling a continuous piece of tread into a fabric or vinyl roll, these are cut to length and stacked in booking trucks and pulled to the second stage machine. The tread may consist of a tread cap on top, a tread base compound, a tread wing which is chemically compatible with the sidewall compound for tread edge adhesion, and an undertread.

The operator selects a tread and places it on the service conveyor which may have centering guides attached. The front edge of the tread is attached to the belt or nylon surface on the drum and the drum is rotated a full revolution. The tread splice is made by hand and should be further stitched to maximize green tack.

Now, the first stage carcass is fitted over an inflatable drum or chuck which will crown the center of the plies and hold the beads in place. Meanwhile, a transfer ring moves over the second stage drum and spring or pneumatically forced segments extend toward the drum to make contact with the belt/nylon/tread package. Once the segments are in place, the drum collapses, leaving the belt package suspended in the transfer ring segments. The transfer ring then glides over the inflated first stage tire carcass where the belt package is centered by laser indicators, released, and then dynamically stitched onto the carcass under some pressure.

At this point the green tire is completely assembled. The next step in the process would be to prepare the tire for curing. This step includes inside and/or outside tire paints, which protect and lubricate the innerliner and ply cords from the curing mechanisms as well as reducing the propensity for trapping air during the cure. These paints also assist in covering voids in the tire surface and allowing the air inside and on the surface of the tire to be evacuated more easily. Once the paint is dry, the tire can be cured.

The exact orientation of one component's splice in relation to others has been found to be significant to ride disturbances such as vibration and ride harshness. Due to the potential for this to generate complaints by customers, techniques to stagger the number of component splices around the tire are used.

Cure

Curing is another area in most tire plants in which at least some of the conditions are standardized for efficiency. In the case of many tire plants, the curing factor which is most often standardized is the platen and curing temperature. For example, it would not be unusual for all tires produced in a particular type to be cured at a fixed temperature above 300 degrees, leaving mainly the amount of time as the variable factor for each specific design.

Prior to curing the tire, cure studies are typically conducted in which multiple thermocouples are placed on a green tire. Additional layers of tread stock are added to the surface to allow thermocoupling for some depth, after this the tire is cured. By sectioning the tire, analysis of the point at which the rubber components are cured without the presence of porosity can be determined. This information will be used to formulate the cure specification for this tire.

Due to the high temperature curing that the tire undergoes, ultimately many of these different rubber components are bonded together in such a way that the individual parts meld together. The desired result of curing is not that the rubber components blend to the extent that they lose chemical integrity or identity, but that the rubber to rubber, rubber to fabric, and rubber to steel bonds produce an intact tire system by the degree to which each component becomes melded to the other. The desired result is that no interface between the components being bonded is weaker than the strength of the individual component, else a failure at that component interface is inevitable, and must be remedied.

Once the tire is cured, it will continue through an inspection process which might include X-ray, uniformity measurement, balance check, sidewall undulation measurement, and/or white sidewall buffing. There should be several opportunities before finally being delivered to a warehouse location for the tire to receive visual, tactile, and instrumented inspection.

DESIGNING A PASSENGER OR LIGHT TRUCK STEEL-BELTED RADIAL TIRE

Simply stated any tire's two main functions are to allow ease in rolling and to allow control of the mass of the vehicle on which it is mounted. This control translates into degrees of precision or handling response (ultra high performance tires being on the upper end of the scale) and the ability to stop (braking) the mass on different surface types in a variety of service and climatic conditions. In the most general of terms, almost every other performance expectation is a desired derivative of those two main functions, including the ability to sustain a certain load and inflation pressure and the ability to continue in service for a reasonable period of time without presenting safety-related modes of failure at the end of serviceable life, such as a tread separation. Consideration of these two primary functions should be incorporated into the tire design process.

As a practical matter, tire designers are given some latitude with variations in tread compounding and gauging, some sidewall compounding options and gauging, and usually fewer options for bead apex compounding. Usually a tire designer can expect more freedom to establish the belt widths, angles, and density, adoption of nylon, ply turn up heights and perhaps type of ply cord selected, and the dimensions of the bead apex. Beyond these, such items as innerliner, bead core coating, nylon chafer skim compound, rim protector compound, ply skim compound, belt skim compound, belt wedge compound, nylon skim compound, belt cushion compound, tread wing compound, and undertread compound are virtually never adjusted by individual designers or for specific tire design programs. These type rubber components (as well as body ply types, nylon types, and to some extent the types of steel used in bead bundles, steel belts, and sidewall inserts) are most often incorporated into every (or nearly so) tire of a given type produced in a given tire plant.

In manufacturing a tire, the beads, innerliner, body plies, and sidewalls are typically assembled in the first stage and the belts, nylon, and tread are assembled over the first stage carcass in the second stage tire building process. This separation of components by stage is also a point of consideration for the design engineer. It is somewhat rare to achieve the total performance requirement in the very first attempt, especially for OE applications. However, the designer must consider that it is somewhat easier to tune a design when the net stiffness of the first stage carcass matches the directional stiffness of the second stage components. For example, if the design requires an improved ride quality, the designer might soften the bead apex, lower the ply turn ups, and thin the sidewall gauges in order to allow the tire's carcass to flex suitably with each large road input.

By comparison the second stage components might include a higher belt angle and an increase in tread base gauge. This would allow the tire to crown in the center line, concentrating the contact area to the center of the tire to reduce road contact inputs across the face of the tread/belt package. The tread base typically has a high percentage of natural rubber content and at a lower hardness than the tread cap provides a cushion between the tread cap and the belts, further reducing transmission of road inputs. This technique of "balancing the tire stiffness" creates a baseline of performance by which the designer can then focus on specific performance changes from further tuning changes in the components, compounds, or gauges of future experimental tire specifications within a specific tire development program.

By the time that the developmental tire mold has arrived, the tire designer should have discussed with the factory process engineers the dimensions of the initial extrusion dies for the tread, sidewall, and bead apex. For the tread, the block width (area of tread to contact the road surface shoulder to shoulder) of the mold should closely match the block width of the extrusion, the split between tread cap and tread base should be informed, and if possible an initial extrusion trial should have been conducted in order to check the stability of the tread compounds (growth and swell out of the die). Meanwhile the chemical laboratory should have taken samples of the tread compounds, if using an experimental formulation, and analyzed the samples by Rheometric analysis, and dynamic strain or temperature sweeps to understand whether the initial batch is expected to deliver the proper performance, whether the rubber batch is thoroughly mixed at the Banbury, and some idea of the scorch temperatures for the new compound.

Much of this work happens simultaneously so that the tire designer may or may not be informed of every detail, but depends upon the factory process engineer to order the extrusion dies to meet his tire build schedule. Also, for those tire designs which are new sizes for a factory, the factory process engineer might coordinate the ordering of new tire building drums, linkages for the bead winder, and new curing bladders for the incoming mold. The materials members might be coordinating the arrival of new components such as silica, coupling agents, unique polymers, etc. if not already in use.

According to the size and type of tire, the tire designer might next consider the type and amount of bead wires used. After selecting the wire to be utilized, the designer should consider the stacking arrangement for the bundle.

If the facility only has taped bead constructions available, the decision becomes how many turns and strands the bead will have. All turns will contain an equal number of strands.

For those facilities which utilize hexagonal or polygonal shapes and single wound wrapping of bead wires, each row of bead wires can be somewhat unique from the layer above or below. Bead burst testing has indicated that the strongest band in any tire's bead should be the lowest strand. Therefore, consideration should be given to establishing an adequate base count and determining the best bundle type from that point.

One consideration in finalizing the bead bundle shape and wire count is the bead apex base width. The uppermost row of bead wires should make it possible to rest the base of the bead apex upon it.

Some of the functions of the bead apex are to generate lower sidewall stiffness centrally in the tire (over the bead). Stiffness outside of this, by sidewall compound alone, for example, doesn't generate the same level of handling precision as that directly over the bead bundle, since the bead bundle is the direct contact to the rim which assists in the transfer of steering inputs by the driver. Another function of the bead apex is to separate the carcass ply and its turn up. This in effect generates a higher degree of carcass tension, which aids in handling maneuvers and also relates to the tire's ability to support the belt and tread package. A third function of the bead apex is to damp vibration inputs before transmission from the road to the rim and into the vehicle's

suspension system, floor-pan, and steering column. Once the bead bundle and the bead apex are selected, ply type and gauge, number of plies, and turn up heights are determined.

In developing a tire for an OEM, soon the tire designer begins to learn the performance preferences of the vehicle engineers he/she is working with. This knowledge comes to bear especially when determining the side stiffness of the tire (bead apex, ply turn up heights and cord type, and sidewall compound selection) along with the matching wire density, belt angle, and tread compound formulations. This being the case, several different tire sizes for different vehicle fitments of one vehicle maker could have relatively similar tire constructions.

OEM considerations aside, the tire designer's task is somewhat more straight-forward when designing for the aftermarket. When establishing designs for sale in tire retail outlets, the designer is tasked with proliferating a range of tires having basically the same features (allowing for size to size deviation in actual performance). As an example, 25 to 30 sizes might be included in the range under one line name. Once the number of sizes is selected, typically by marketing input, several of the sizes might be selected due to the expectation of sales volume they will generate and these might be determined to be the key sizes to receive the largest battery of tests. Other sizes for which marketing has predicted lower volume might not be specifically evaluated in benchmarking comparisons with competition or costly endurance testing until much nearer the time of product launch for the whole line of tires to the market. This isn't to say that the approach mentioned above is the universally accepted methodology for releasing a range of products, but it is one method employed from time to time in the tire industry.

I mentioned the designer's task in designing an aftermarket tire is more straight-forward because it is often the case that tire designers establishing a new line of tires will generate, in one form or another, a matrix for the entire line in which the designs for the key sizes are established based upon competitive analysis and perhaps incumbent products with which the designer is familiar. Once the key tire size designs are determined, the designs of the additional sizes are filled into the matrix by factorization; meaning, the component dimensions are factored up or down from the key sizes (or max and min sizes) based upon the dimensional relation of the specific tire sizes themselves.

In this way mold and design drawings can be rationalized (minimized) by overlaying several desired profiles onto one drawing, or utilizing one stamping drawing to demonstrate the placement and text on the sidewall for virtually the whole line of products. This is sometimes termed "embedding" designs.

Whichever approach is administered in the design of the tire, the tire designer still maintains the responsibility to ensure the tire meets all testing standards for durability, safety, and regulatory requirement before release to production. The initial production tires should be monitored and retested to confirm previous performance levels are maintained after mass production commences.

The next step in determining the initial design of a tire might be to decide on the belt materials and settings. Here again, the belt material is one of those components which can represent a "bottleneck" for a manufacturing site if multiple wire types are introduced. Multiple wire types

in the manufacturing environment create complexity in the management of various wire types through creeling (stringing multiple spools of belt wires), calendaring (applying belt skim to the creeled wires), belt roll storage, and cutting operations.

Design decisions regarding steel belt specifications could include:

- Belt angle orientation. For markets driving on the right-hand side of the road a standard has been established for which angles should be nearest the tread pattern. Apply these incorrectly and the tire may have a strong tendency to drift sharply off the road to the right-hand shoulder. Applied correctly, the tire should have some corrective tendency to either maintain a straight track or drift slightly against the grade of the road, even when the road has 1 to 3% cant angle. The reverse is true for markets in which vehicles are driven on the left-hand side of the road.
- Belt width should create an appropriate belt to belt step off. Too little difference in the widths of the 1st and 2nd belts and the potential for coincidental endings which generate higher heat on the belt edges due to the flexion occurring near the uncoated ends of the cut belts exists. Too large a difference in belt widths and the endurance of the tire is compromised when the 2nd belt does not cover the full tread width in contact with the road, creating higher loading on the point where the 2nd belt hinges to the 1st belt.
- Belt angle affects the final cured tread radius. The higher the angle the more “crowning” which will occur in the inflated tire. This is a result typically sought for tires meant to exhibit more ride comfort qualities than handling precision. Noise and rolling resistance are also improved in this manner as the shoulder drag is reduced when the center has more contact, and with the shoulder pressure reduced there are several frequencies of noise which are reduced in the road noise, belt edge resonance, and pattern noise frequency ranges (between 125 and 2000Hz).
- Typically belt skim and belt skim gauge for manufacturers who do not utilize unbalanced belts are standardized for a particular tire type. Therefore this element would not usually be decided by the tire designer. Again, the chemists and service compounders would be required to certify that the proper anti-degradants (anti-ozonants and anti-oxidants) were included in the belt skim mix in appropriate content to handle the heat and flexion encountered throughout the lifecycle of the tire. Also, these or additional anti-degradants are required to handle the potential for chemical aging and exposure to climactic elements during the lifecycle of a tire.
- Also, typically the belt cushion (whether designed as the upper taper of the sidewall extrusion or as an individually extruded wedge of rubber) is predefined by those involved in studying the green tire components based on the belt widths and overall tire height dimension provided by the tire designer. The gauge and width dimension of the belt cushion would be fairly consistent from tire to tire.
- Belt wedge or belt edge gumstrip is also rarely modified either in chemical composition or dimension.

Next, the designer must determine whether the tire should have a nylon band component over the belts due to usage, speed rating, load rating, DOT plunger test, or specific customer requirements for handling or noise control.

The nylon used in tire designs has excellent thermal-set properties to allow it to shrink with heating and apply additional resistance to a steel belt system, which ultimately tends toward lifting from the fabric-based carcass beneath it, due to differences in rigidity, steel spring memory, centrifugal forces, mechanical forces generating strain and stresses including compression and tension at various points around the tire and during each loaded revolution of the tire's use.

Before the advent of wound nylon strips, called spiral nylon over wrap or bands by some manufacturers, the inclusion of a full belt width of nylon created some challenges for tires. These included morning flatspotting for the first several miles of driving each day and the possibility for the splice to pull apart during the growth encountered when the tire was cured. This required the splice to be overlapped overly wide to ensure good final splice coverage.

With nylon strips, the heavy overlap is virtually removed. The result is the same qualities of nylon to sustain the belts, increased high speed performance, increased plunger strength, isolated road noises, increased handling response, and better management of heat under higher loads--while eliminating the periodic thumping of a heavy nylon splice—though flatspotting can still be an issue.

In the absence of a more economical and technically-capable belt bandage, nylon is certainly appropriate for a multitude of design considerations. Nylon hybrids and Kevlars are certainly available; but with limited use and adoption, it is not likely in the near term that these will compare to nylon on a cost per linear foot basis. I've expressed several applications for nylon, yet some manufacturers continue to refuse to adopt nylon due to the cost impact--though I know of no material substitute for it which even comes close to its cost, while providing a safer, alternative design.

I have explained some performances about which the tire designer must be aware during the development cycle for a new tire. I have discussed at some length the individual components and the decision process around some of them regarding selection to meet certain test criteria. In doing so, I believe I have mentioned several components which are nearly universally used in tires of a specific category, be it passenger and light truck or others. These might include innerliners, bead wire and skim, ply cord types, ply skim stocks, chafer fabric and skim stocks, belt wire, belt cushion, belt wedges, belt skim stocks, undertread compounds, tread base compounds, rim protector compounds, nylon cap ply fabric and nylon skim stocks.

The processing aids for any of these rubber components are oils, tackifiers, peptizers, plasticizers, and softeners. The curatives are accelerators, activators, and sulfur. The adhesion promoters are coupling agents, cobalt salts, brass on wires, and resins on fabrics. The anti-degradants are antioxidants, antiozonants, and paraffin waxes. The reinforcing materials are carbon black, silica, and resins.

It is vitally important to realize that when a specific tire product begins to show unacceptable performance, one common link to other products is the use of the universal components within a single factory or set of factories. This overview can help those investigating to isolate root cause effects from others, and hone in on the major factors involved.

Another link shared with the suspect tire is the historical performance of chemical ingredients such as the processing aids, curatives, adhesion promoters, anti-degradants, and reinforcing materials being used by a particular tire manufacturer or a specific factory. The way in which those specific ingredients are handled within the factory, the methods used to load them into the Banbury mixing process, the time given for the proper milling of the rubber stocks, the efforts taken to protect the prepared component from environmental contamination, blooming, or aging—all of these considerations may not be entirely evident from a single tire, yet by understanding the overall methodology involved at the manufacturing site, the tire designer, field service manager, or forensics analyst can better identify all the contributing factors surrounding the lack of performance, whether that is a product integrity issue or achieving a certain level of new tire performance.

It has been my experience that the category of passenger tires has transitioned from 13” and 14” tires in the late 1980s to now extend well into the 20” diameter range. The fitments for passenger tires have been extended to pickups and SUV’s by the major OEM’s of the world. Further the vehicle categories themselves have blurred from the standard categories offered in the 1980s, from sedans to sedan-type multi-use vehicles, from pickup trucks to six-passenger SUV’s with payloads of three quarters of a ton.

Just as this transition has occurred in vehicle categories, some of the distinctions for the tire types being used have also been blurred creating similarities between (P-metric) passenger and (LT) light truck tire designs. The exceptions are typically in tread pattern depth and type. With the increase in passenger tire overall diameters, the tire building and curing machinery is basically identical between the two segments these days. The tire building personnel (tire builders and curing room operators) may build either type of tire interchangeably. The training they have had in either type of tire production being adequate for the other.

Having given thought and consideration to each of the design steps previously mentioned, the tire designer awaits the arrival of the mold, then initiates the first specification upon its delivery. Once the tire specification is produced, the tires might be footprinted for contact shape, sectioned for gauge and component placement confirmation, and evaluated for uniformity. If each of these is deemed to meet the specification, the tire might enter a more thorough testing battery. Otherwise, the process is restarted with perhaps three to five additional variants included in the new specification requests, until an acceptable specification is realized.

TIRE FORENSIC ANALYSIS METHOD

I examine tires that have been involved in tread separation accidents in a specific manner, which is the same manner used by other tire experts, both plaintiff and defense. I have confirmed this by meeting and discussing this topic with other tire experts. It is also the same manner that I used while working in the tire industry for Goodyear-Dunlop.

The objective is to try to determine the cause(s) of the tire failure. The examination starts with a visual examination of the outside of the tire, including sidewalls and beads, carcass, and tread. Tire markings and codes are noted. Any cuts, bruises, or other damage is noted. The tread and steel belts are inspected. Measurements are made of locations of markings and abnormalities. Then the inside of the tire is inspected visually. Close attention is given to any punctures, innerliner problems, including gauge, splices, cuts, or other abnormalities. At the same time, a tactile inspection is made. All surfaces, both exterior and interior, are felt for abnormalities.

Various devices are used in the tire examination, including spreaders, high intensity lights, magnifying devices, laser non-contacting devices, and microscopes. X-rays are done if appropriate. Shearography use is considered and ordered if appropriate. The companion tires at the time of the accident are examined if available. The subject wheel is closely inspected, as are the companion wheels, if available. Then I take photographs of the condition of the subject tire to document and show its condition. Also, as important as the positive findings on the tire, is the absence of signs on the tire. Most user-caused conditions will leave tell-tale signs on the tire. Their absence is strong evidence that the tire was not significantly, adversely affected by improper use or maintenance. This is the method that I used in the examination of the subject tire.

I also employ the scientific method in conjunction with my tire examination, experience, education, training, and scientific and technical literature, studies, and testing, as applicable, to reach my tire failure analysis and defect opinions in this report.

I have reviewed the following materials in this matter:

- My subject tire dismounting video
- My RR, LR, and LF companion dismount videos and rim valve stem test videos
- My RR, LR, and LF companion tire xrays
- My subject tire xrays
- Kumho Road Venture Complaints on NHTSA's Website
- Accident report
- Deposition of [REDACTED]
- Deposition of [REDACTED]
- Deposition of [REDACTED]
- Deposition of [REDACTED]
- Deposition [REDACTED]
- Affidavit of [REDACTED]
- Affidavit of [REDACTED]
- My affidavit in support of Plaintiffs' Motion to Compel Discovery
- Documents produced by Kumho
- Police Scene Photos
- My inspection notes of the subject and companion tires and rims
- My laser profiles
- My photographs of the subject and companion tires and rims
- Test #140007A1—produced by me in this matter
- Test #140008A1—produced by me in this matter
- Test #110003A1/A2/B1

- Test #110002A1/A2
- Test #140001A1/C2
- My reference materials
- My rim groove article
- SAE paper and video of impact testing conducted by Dennis Carlson and others
- Test #130009A1/B1/C1/D1 and peel strength test results in [REDACTED]
- Deposition of [REDACTED] in [REDACTED]
- Deposition of [REDACTED] in [REDACTED]
- Other Instances of trapped air in tread separation cases
- Other Instances of cord shadows in tread separation cases
- Other Instances of coincidental belt endings in tread separation cases
- Other Instances of irregular belt spacing in tread separation cases
- Other Instances of gapped belt splices in tread separation cases
- Other Instances of dog-eared belt splices in tread separation cases
- Other Similar Instances of Kumho Road Venture Cases of tread separation which I have personally inspected, including: [REDACTED] v Kumho, [REDACTED] v Kumho, and [REDACTED] v Kumho.
- Toyo Recall Documents
- LR and RR Companion Tire Shearographs

HISTORY/ INCIDENT:

On September 12, 2011, a 2001 red Ford F250 driven by [REDACTED] traveling northbound on HWY 69. The vehicle had a blown tire on the front right side. This resulted in the vehicle leaving the roadway on the right shoulder and rolling over. This incident resulted in [REDACTED] [REDACTED] being ejected from the vehicle and suffering serious injuries.

The DOT (found on the serial side of the tire's sidewall, called SS in my report) was considered the starting point or 0 degrees. Rotating clockwise around the sidewall, my inspection notes were taken in increments of 30 degrees. The opposite side of the tire was evaluated in the same way; however, rotating counterclockwise in order to be consistent side to side. The tread and carcass were also measured in increments of 30 degrees starting above the DOT.

RECEIVAL NOTES

- Received one (1) wooden crate containing the subject tire, mounted on an eight (8) lug alloy rim.
- Seated inboard, debaded outboard.
- Photos made before and after removal from crate and before dismount.
- Case name, attorney name, valve stem location and clip weight locations marked on tire prior to dismount.
- Dismount was videotaped.
- SS sidewall (OWL) mounted outboard.

FINDINGS: SUBJECT TIRE

SS MARKINGS

- Kumho Road Venture AT
- LT235/85R16
- 120/116Q
- Load Range E
- 10 ply rating
- Max load single: 1380 kg (3042 lbs.) at 550 kPa (80 psi) cold
- Max load dual: 1260 kg (2778 lbs.) at 550 kPa (80 psi) cold
- Tread: 2 steel + 2 polyester + 1 nylon
- Sidewall: 2 plies polyester

- N009
- DOT K20R YD4A 3508
- Made in Vietnam
- RTN KL78 002
- E4 0019691
- Rim warning – mount only on 16 inch radial rims
- Safety warning

SOS MARKINGS

- Tubeless radial

INTERIOR MARKINGS

- 06 A4 16_D

SS INSPECTION

- No bead damage this sidewall.
- Rim groove (4.2 x 0.5).
- 120 degrees—valve stem location.
- 150 degrees SS-345 degrees SOS—tread and #2 belt lifted.
- 190 degrees—radial and circumferential upper sidewall tear.
- 225 degrees—clip weight impression.
- 235 degrees—clip weight impression with matching rim weight.
- 320-10 degrees—circumferential sidewall tear.

SOS INSPECTION

- No bead damage this sidewall.
- Rim groove (4.3 x 0.5).

- 145-315 degrees—tread and #2 belt lifted at buttress.
- 310 degrees—radial split.
- 315-335 degrees—tread, #2 belt and buttress missing.
- 345 degrees—clip weight impression.
- 350 degrees—clip weight impression with matching rim weight.

INSIDE INSPECTION

- 360 degrees—visible cord shadows.
- 195 degrees SS of C/L—radial and circumferential split/tear.
- 295-315 degrees SOS—three (3) radial splits connected by a jagged diagonal tear that extends to 325 degrees SS and connects another radial split.
- 325 degrees SS-5 degrees—circumferential sidewall tear.
- No punctures or repairs noted.

TREAD FLAP INSPECTION

- Ranges 150-305 degrees SS or 150-345 degrees SOS, attached to carcass at 150 degrees.
- Appears virtually all tread available.
- Chip and tear wear on tread throughout.
- Nylon cap ply construction.
- Oxidation on both shoulders throughout tire.
- 345-280 degrees SOS—major crescent shaped zone of oxidation with stripped and frayed #2 belt wires.
- 345-150 degrees—eighteen (18) adhesion-arrest marks.
- 270 degrees SS-C/L—broken #2 belt cable at puncture location.
- 245 degrees C/L—broken #2 belt cable at puncture location.

- 195 degrees C/L—broken #2 belt cables at puncture location.
- 205 degrees C/L—broken #2 belt cables at puncture location .
- 260-180 degrees SS—trapped air impressions.
- #2 belt width ~ 170 mm.
- Tread block width ~ 185 mm.
- 320-150 degrees—tread attached with chip and tear.

CARCASS INSPECTION

- 150-330 degrees—range of exposed carcass.
- Approximately twenty-one (21) adhesion-arrest marks.
- Oxidation on both shoulders throughout.
- 180-195 degrees SS—trapped air impressions.
- 210-225 degrees SS—trapped air impressions.
- 235 degrees SS—trapped air impressions.
- 260-270 degrees SS—trapped air impressions.
- 280-310 degrees SOS—#1 belts lifted and oxidized.
- 290 degrees SOS—radial split.
- 290-310 degrees SOS—circumferential tear.
- 310-335 degrees—diagonal tear through carcass.
- 310-330 degrees SS—minor crescent shaped zone of oxidation.
- 285-345 degrees SOS—major crescent shaped zone of oxidation connecting from 320-330 degrees.
- 330 degrees SS—belt step-off ~ 2.7 mm.
- 240 degrees SOS—belt step-off ~ 5.2 mm.

TREAD DEPTHS

	SS1	SS2	SS3
0	3.5	2.9	2.9
30	3.9	3.2	3.7
60	4.2	2.8	3.3
90	3.2	2.6	3.3
120	4.3	2.4	3.4
150	4.0	3.1	3.5
180	3.9	3.2	2.9
210	4.0	3.2	3.7
240	4.2	3.7	3.0
270	3.4	3.0	3.6
300	3.7	2.7	2.9
330	4.0	3.3	---

RIM MARKINGS OUTBOARD

- No markings noted.

RIM MARKINGS INBOARD

- 16X7K
- DOT-T
- Ford
- C
- 2
- 020801

- 1C34-1007-AA

RIM MARKINGS INTERIOR

- No markings noted.

RIM INSPECTION OUTBOARD

- Valve stem, core and cap installed.
- Valve core checked for leaks.
- One (1) 0.5 MC clip weight installed.
- No damage noted.

RIM INSPECTION INBOARD

- One (1) 1.0 MC 28 clip weight installed.
- No damage noted.

RIM INSPECTION INTERIOR

- No damage noted.

SUBJECT TIRE XRAYS

Carcass 0 degrees:

- Coincidental belt endings

Carcass 30 degrees:

- Coincidental belt endings
- Irregular belt wire spacing
- Gapped #1 belt splice

Carcass 60 degrees:

- Snaking
- Irregular belt wire spacing

- Gapped #1 belt splice

Carcass 90 degrees:

- Slight dog-eared and gapped #1 belt splice
- Irregular belt wire spacing

Carcass 120 degrees:

- Snaking
- Irregular belt wire spacing

Carcass 150 degrees:

- Coincidental belt endings
- Spread cables
- Irregular belt wire spacing
- Gapped #2 belt splice

Carcass 180 degrees:

- Irregular belt wire spacing

Carcass 210 degrees:

- Irregular belt wire spacing
- #2 wire ends frayed and broken

Carcass 240 degrees:

- Irregular belt wire spacing
- Abraded #1 belt cables
- #2 belt wire ends frayed and broken

Carcass 270 degrees:

- Irregular belt wire spacing

- Frayed #1 belt ends

Carcass 300 degrees:

- Irregular belt wire spacing
- Stripped #1 belt wires

Carcass 330 degrees:

- Coincidental belt ends
- Irregular belt wire spacing
- Belt ends stripped and frayed

Tread 180 to 210 degrees:

- Irregular belt wire spacing
- Gapped #2 belt splice

Tread 240 to 270 degrees:

- Broken and abraded #2 belts

Tread 300 degrees:

- Stripped and frayed belt ends

FINDINGS: LF COMPANION TIRE

RECEIVAL NOTES

- Received three (3) wooden crates. One crate contained the LF companion tire mounted on a steel rim.
- Debeaded on both sides.
- SS side mounted inboard.
- Photos made before and after opening crate.
- Case name, attorney name, and outboard sidewall marked prior to dismount.
- Dismount was videotaped.

SS MARKINGS

- General Grabber AW
- LT235/85R16 120/116Q M + S
- DOT AD0R 1JC 0701
- Load Range E
- Tubeless Radial
- Max load single 1380 kg (3042 lbs.) at 550 kPa (80 psi) cold
- Max load dual 1260 kg (2778 lbs.) at 550 kPa (80 psi) cold
- Tread 4 plies: 2 steel + 2 polyester
- Sidewall plies: 2 polyester
- 2830402A
- Made in USA
- N020
- EK-65564

- L7611
- 46089
- E4 009112
- Safety warning

SOS MARKINGS

- DK-65562

INTERIOR MARKINGS

- 5216
- 0090

SS INSPECTION

- No radial splits or bead damage.
- Rim groove (7.4 x 1.0).
- 220-315 degrees—sidewall creased.

SOS INSPECTION

- No radial splits or bead damage.
- Rim groove (7.7 x 1.1).
- 30-40 degrees—spare bracket impression.
- 100 degrees—clip weight impression.
- 100-180 degrees—sidewall creased.
- 135-150 degrees—spare bracket impression.
- 210-225 degrees—spare bracket impression.
- 225-310 degrees—sidewall creased.
- 325-335 degrees—spare bracket impression.

INTERIOR INSPECTION

- 105 degrees—angled innerliner splice (cracked SS-SOS).
- 220 degrees—ply splice.
- 270 degrees—ply splice.
- 335 degrees—ply splice.
- 345 degrees—ply splice.
- No punctures or repairs noted.

TREAD INSPECTION

- No punctures or repairs noted.
- Vent bases still visible on tread surface.

TREAD DEPTHS

	SS1	SS2	SS3	SS4
0	9.9	10.3	10.6	10.4
90	10.1	10.2	10.3	10.3
180	9.9	10.2	10.7	10.3
270	10.7	10.0	10.4	10.8

RIM MARKINGS OUTBOARD

- Ford
- 1 1 050
- 233
- S
- F81A-1015-AA
- 16X7K

- Accuride
- DOT T
- Canada
- 02 20 01
- 1L1 40
- 32071

RIM MARKINGS INBOARD

- No markings noted.

RIM MARKINGS INTERIOR

- No markings noted.

RIM INSPECTION OUTBOARD

- Valve stem, core, and cap installed.
- Valve stem is broken at base – could not test core for leakage.
- No clip weights installed.
- Minor flange abrasions.
- Ford 8-lug steel rim (gray painted).

RIM INSPECTION INBOARD

- No clip weights installed.
- No damage noted.

RIM INSPECTION INTERIOR

- No damage noted.

FINDINGS: RR COMPANION TIRE

RECEIVAL NOTES

- Received three (3) wooden crates. RR companion tire was in one crate, mounted on an alloy rim, and inflated to -31.5- psi at time of removal from crate.
- SS sidewall mounted outboard.
- Case name, attorney name, valve stem location, and clip weight locations marked on tire prior to dismount.
- Photos made before and after opening crate.
- Dismount was videotaped.

SS MARKINGS

- Kumho Road Venture A/T
- LT235/85R16
- 120/116Q M + S
- Load Range E
- 10 ply rating
- DOT K20R YD4A 3608
- Max load single 1380 kg (3042 lbs.) at 550 kPa (80 psi) cold
- Max load dual 1260 kg (2778 lbs.) at 550 kPa (80 psi) cold
- Tread 5 plies: 2 steel + 2 polyester + 1 nylon
- Sidewall plies: 2 polyester
- Made in Vietnam
- PTN KL78 001
- E4 0019691

- Radial Tubeless
- N009
- Safety warning

SOS MARKINGS

- No additional markings.

INTERIOR MARKINGS

- TIEN
- JR13-5A
- 08 A4 115A

SS INSPECTION

- No radial splits or bead damage.
- Rim groove (4.0 x 0.8).
- 55 degrees—valve stem location.
- 285 degrees—clip weight impression with matching rim weight.
- 305 degrees—clip weight impression with matching rim weight.

SOS INSPECTION

- No radial splits or bead damage.
- Rim groove (6.0 x 0.7).

INTERIOR INSPECTION

- 360 degrees—cord shadows noted.
- 65 degrees—ply splice.
- 85 degrees—straight innerliner splice.
- 310 degrees—ply splice.

- 315 degrees—ply splice.
- No punctures or repairs noted.
- 360 degrees SS and SOS—hollow beads.

TREAD INSPECTION

- No punctures or repairs noted.
- Some chunking and abrasion noted throughout.

TREAD DEPTHS

	SS1	SS2	SS3
0	6.2	6.7	5.5
90	6.2	6.9	6.3
180	6.2	6.5	5.9
270	6.1	6.8	5.9

RIM MARKINGS OUTBOARD

- None noted.

RIM MARKINGS INBOARD

- 16X7K
- DOT-T
- Ford
- C
- 1 020801
- 1C34-1007-AA

RIM MARKINGS INTERIOR

- 02 9 2001

- 223179

RIM INSPECTION OUTBOARD

- 8-lug Ford alloy rim.
- Valve stem, core, and cap installed (tested for leaks; did not leak).
- One (1) 2.0 MC 57 clip weight installed.
- One (1) 0.5 MC 14 clip weight installed.
- No damage noted.

RIM INSPECTION INBOARD

- No clip weights installed.
- No damage noted.

RIM INSPECTION INTERIOR

- No damage noted.

RR COMPANION TIRE XRAYS

Carcass 0 degrees:

- Coincidental belt endings
- Irregular belt wire spacing

Carcass 30 degrees:

- Coincidental belt endings
- Irregular belt wire spacing

Carcass 60 degrees:

- Coincidental belt endings
- Irregular belt wire spacing

Carcass 90 degrees:

- Coincidental belt endings
- Irregular belt wire spacing

Carcass 120 degrees:

- Snaking
- Irregular belt wire spacing
- Spread cables

Carcass 150 degrees:

- Irregular belt wire spacing

Carcass 180 degrees:

- Irregular belt wire spacing
- Offset belts

Carcass 210 degrees:

- Gapped #1 belt splice
- Irregular belt wire spacing

Carcass 240 degrees:

- Irregular belt wire spacing

Carcass 270 degrees:

- Snaking
- Coincidental belt endings
- Gapped and dog-eared #2 belt splice
- Irregular belt wire spacing

Carcass 300 degrees:

- Snaking

- Coincidental belt endings
- #2 gapped belt splice
- Irregular belt wire spacing

Carcass 330 degrees:

- Coincidental belt endings
- Large dog-eared splice
- Irregular belt wire spacing

- **FINDINGS: LR COMPANION TIRE**

RECEIVAL NOTES

- Received three (3) wooden crates. LR companion tire was in one crate, mounted on an 8-lug alloy rim.
- Debeaded outboard, seated inboard.
- Case name, attorney name, clip weight locations, and valve stem location marked on tire prior to dismount.
- SS sidewall mounted outboard.
- Dismount was videotaped.

SS MARKINGS

- Kumho Road Venture A/T
- LT235/85R16 120/116Q M + S
- DOT K20R YD4A 4008
- Max load single 1380 kg (3042 lbs.) at 550 kPa (80 psi) cold
- Max load dual 1260 kg (2778 lbs.) at 550 kPa (80 psi) cold
- Tread 5 plies: 2 steel + 2 polyester + 1 nylon
- Sidewall plies: 2 polyester
- Made in Vietnam
- PTN KL78 006
- E4 0019691
- Tubeless Radial
- N009
- Safety warning

- Load Range E
- 10 ply rating

SOS MARKINGS

- No additional info.

INTERIOR MARKINGS

- 09A40_ _ _ _

SS INSPECTION

- No radial splits or bead damage.
- Rim groove (6.8 x 0.9).
- 270 degrees—valve stem location.
- 340-350 degrees—abrasion on upper sidewall through coverall and into white rubber.
- 350 degrees—clip weight impression with matching rim weight.

SOS INSPECTION

- Almost 360 degrees—butterfly, S-diameter, and upper sidewall cracking under flexing.
- No radial splits or bead damage.
- Rim groove (4.0 x 0.6).
- 10 degrees—clip weight impression with matching rim weight (slightly slipped).

INTERIOR INSPECTION

- 360 degrees—cord shadows noted.
- 75 degrees—straight innerliner splice.
- 165 degrees—ply splice.
- 195 degrees—ply splice.
- 225 degrees—ply splice.

- 305 degrees—ply splice.
- No punctures or repairs noted.
- 360 degrees SS and SOS—hollow beads.

TREAD INSPECTION

- Some abrasion and chip and tear noted throughout.
- No punctures or repairs noted.

TREAD DEPTHS

	SS1	SS2	SS3
0	6.6	7.0	5.2
90	6.5	6.5	5.5
180	6.5	7.4	5.7
270	5.9	7.4	5.7

RIM MARKINGS OUTBOARD

- No markings noted.

RIM MARKINGS INBOARD

- 16X7K
- DOT T
- Ford
- 2
- 020701
- 1C34-1007-AA

RIM MARKINGS INTERIOR

- No markings noted.

RIM INSPECTION OUTBOARD

- 8-lug Ford alloy rim.
- Valve stem, core, and cap installed (tested for leaks; did not leak).
- One (1) 0.25 clip weight installed.
- No damage noted.

RIM INSPECTION INBOARD

- One (1) 1.25 GMA 35 clip weight installed.
- No damage noted.

RIM INSPECTION INTERIOR

- No damage noted.

LR COMPANION TIRE XRAYS

Carcass 0 degrees:

- Coincidental belt endings
- Irregular belt wire spacing

Carcass 30 degrees:

- Coincidental belt endings
- Irregular belt wire spacing

Carcass 60 degrees:

- Irregular belt wire spacing

Carcass 90 degrees:

- Offset belts
- Irregular belt wire spacing

Carcass 120 degrees:

- Dog-eared #2 belt splice
- Snaking
- Irregular belt wire spacing

Carcass 150 degrees:

- Coincidental belt endings
- Snaking
- Gapped #2 belt splice
- Irregular belt wire spacing

Carcass 180 degrees:

- Coincidental belt endings
- Large dog-eared splice
- Gapped #1 belt splice
- Irregular belt wire spacing
- Snaking

Carcass 210 degrees:

- Gapped #1 belt splice
- Irregular belt wire spacing

Carcass 240 degrees:

- Snaking
- Irregular belt wire spacing

Carcass 270 degrees:

- Coincidental belt wires
- Irregular belt wire spacing

Carcass 300 degrees:

- Coincidental belt wires
- Irregular belt wire spacing

Carcass 330 degrees:

- Offset belts
- Irregular belt wire spacing
- Coincidental belt endings

ANALYSIS

Upon the examination of the subject tire, I made the following observations which, together with my education, background, training and experience and utilizing generally accepted methodologies and procedures widely utilized in the field of tire failure analysis indicate to me evidence of defects in the manufacture and/or design of the tire, which in my opinion *are* defects that caused or contributed to cause the tread separation on the subject tire that led to a loss of control and the resulting accident . Those observations are as follows:

1. Inadequate bonding of the belt skim is evidenced by poorly bonded rubber skim material between the steel belts. This poor bonding was observed by:
 - Trapped air/steam blister impressions present on the belt skim material. Trapped air is air that is captured within the tire at the time of manufacture and is itself a separation manufactured within the material of the tire. Bonding of laminated materials cannot exist properly in areas separated by trapped air. This is a manufacturing defect which caused or contributed to cause this tire failure.
 - [***Tire Talk-Lateral Stiffness-Tire Belt Packaging***, “There isn’t a lot of rubber in the area occupied by the belt edge covers and little material to absorb heat, which occurs at very high frequency. If the manufacturer isn’t careful, this is an area where air can become trapped. Air caught inside will try to permeate through the innerliner and go to that hot spot, causing a belt-edge lift or separation.” www.tomorrowstechnician.com]
 - [***LanXess Halobutyl Tire Innerliners Problem Solving Guide***, “Cure tire blisters: 1) Excessive air trapped at tire assembly. (2) Poor innerliner to carcass tack. (3) Poor hot cured adhesion between liner and carcass.”]
 - [***L-RAY Introducing Differometry***, “Detect the following tire anomalies by using the L-Ray Tire Analyzer: (a) Identifies air trapped in cured tire as a result of variations in the thickness of green tire components. (b) Porosity and voids. (c) Separation. (d) Undercure. (e) Trapped air and bubbles. (f) Low interplay adhesion. (g) poor cord adhesion and bare wire detection. (h) broken cords. (i) build machine checkouts, e.g. stitchers. (j) fatigues.”]
 - [***US Patent US2009/0255620 A1, Oct. 15, 2009, Sawada, Yokohama Rubber Co. Ltd. Method of Producing Pneumatic Tire***. “If the green tire thus formed is cured, the air in the void is not fully absorbed into the rubber layer, thus leading to occurrences of blisters. Such blisters not only significantly disfigure the inner

surface of the tire, but also may cause a breakage or separation of the thermoplastic resin film during use of the tire.”]

- [***Unprotected testimony of Thomas Johnson of GDTNA in*** [REDACTED] v [REDACTED], “Q: Okay. Now, in fact, in the kind of marks that we’re talking about now, if they haven’t disappeared from the process, that could very well mean that vulcanization somehow wasn’t proper for that particular tire. Correct? A: It doesn’t have to mean that the elements can vulcanized. It can just simply mean that there’s been an air-air in that location. It can mean that—that there has been a lack of consolidation of the material before curing.”

- Q: How does air get in there, air bubbles or gas? A: Well, trapped air due to stitching which is largely automated now. Q: Okay. A: And lack of stitching pressure. And that’s probably the most common source.]

- Images of trapped air/steam blister impressions compared with Dennis Carlson support my opinion as to the appearance of trapped air impressions in the subject failed tire.

2. The presence of premature oxidative degradation on the belt skims which indicates that it was not capable of managing the heat, stress, strain, flexion, and oxygen exposure being generated between the steel belts of the subject tire. These conditions are normal and calculable considerations for the designer at the time the tire is designed and manufactured. Belt skim rubber is enriched with antioxidants. The function of those antioxidants is to chemically link to any oxygen attacking the rubber. This function maintains the original properties of the rubber until the antioxidants are depleted. At the point of effective antioxidant depletion, the rubber is affected in several ways including cracking, polishing, and a loss of elasticity. With a loss in elasticity, the belt skim cannot flex with the steel belts as they rotate into contact with the road, ultimately separating the belt wires from the rubber. A lack of adequate antioxidant remaining in the skim stock and/or in the original compounding of the skim stock rubber to allow a tire manufactured in 2008 to operate properly in 2011 contributed to the accelerated oxidative degradation of the tire. This is a manufactured defect in the subject tire which caused or contributed to cause this tire failure.

- [***DEKRA-Technical Defects on Motor Vehicles 1986***, “Separation due to over-aging of the tire... If the measured shore value is considered higher than 70 degrees, it is a warranted conclusion that the vulcanized material has become hardened and brittle. In most instances, this is a result of the aging of the rubber.” “But modern rubber blends contain protective agents against aging that prevent the vulcanized material from becoming brittle prematurely. Nevertheless, a diffusion of oxygen molecules attaching themselves to the free binding ends of the molecular chains still occurs; thus, even modern tires are subject to a

certain amount of aging. This can translate into fine tears due to brittleness in the tire surface.”]

- [***British Rubber Manufacturers Association, Tyre-Ageing June 5, 2001***, “Rubber compounds used in modern tyres contain anti-oxidising chemicals, which slow down the rate of ageing. However they cannot eliminate “ageing” altogether...Tyre ageing is often identified by small cracks (crazing) appearing in the tyre sidewall and other flex areas...However, tyre “ageing” may not exhibit any external indications and, since there is no non-destructive test to assess the serviceability of a tyre, even an inspection carried out by a tyre expert may not reveal the extent of any deterioration.”]
- [***Effects of Aging on the steel cord- rubber Interface, Bekaert June 27, 1985***, ”In most cases, the adhesion loss due to heat and mould aging is, at least partially, caused by rubber degradation. Oxidation may alter the bulk and interface rubber properties.”]
- [***Factors that Affect the Fatigue Life of Rubber: A Literature Survey, Mars, Cooper Tire and Rubber to American Chemical Society April 29, 2002***, “Oxygen influences mechanical fatigue behavior in at least two ways. First, exposure to oxygen decreases the mechanical fatigue crack growth threshold from its value in vacuum. Second, oxygen dissolved or diffused in the rubber may induce chemical changes over time to the bulk elastomer network structure; this process is commonly called oxidative aging. Oxidative aging causes embrittlement and reduced resistance to fatigue crack growth. Even for new rubber specimens with no prior exposure, the presence of oxygen increases the fatigue crack growth rate, at constant energy release rate.”]
- [***Belt edge deterioration in radial steel belted tires, by Uday Karmarker in Rubber and Plastics News, Nov. 27, 2006***, “A new tire aging standard requires understanding the aging mechanisms in tires and devising an accelerated laboratory test to match field behavior...NHTSA has published data on tires collected from Phoenix. Thermo-oxidation has been cited as the root mechanism of tire aging...Time (field age), temperature (tire design and usage) and cavity gas partial pressure of oxygen (nitrogen purity in tire) are the critical external factors influencing the belt edge deterioration.”]
- Images of premature oxidation compared with Dennis Carlson support my opinion as to the appearance of premature oxidation in the subject failed tire.

3. The subject Kumho tire exhibits the following belt irregularities: coincidental belt endings, irregular belt wire spacing, gapped belt splices, dog-eared splices, snaking and spread cables. The impact of this irregularity in spacing is that these contribute to heat generation and increase in stresses and strains along and surrounding these points of poor splicing. This lack of process control is a manufacturing defect, which caused or contributed to cause this tire failure.
 - [*What's Riding on Your Tires?, Jill Bartel, NTIAC, Department of Defense, Volume 25 No. 5, "Tires are a laminated process—layers of vulcanized rubber and corded fibers bonded together. If these layers are flawed in some way, they can cause the tire to fail catastrophically. A number of factors can lead to defective tires: (a) abnormal cord spacing. (b) wander, snaking, scalloping, necking, and flare in belt..."*]
 - Images of belt defects compared with Dennis Carlson support my opinion as to the appearance of belt defects in the subject failed tire.
 - The x-rays of the companion Kumho tires support this opinion and demonstrate the fact that these defects were prevalent in the manufacturing processes at Kumho's factory.
4. The subject Kumho tire exhibits cord shadows on the innerliner. This indicates an inadequate innerliner gauge or thickness. The function of the innerliner (through both gauge and halobutyl content) is to retard the permeation of air and moisture through the body of the tire where oxygen and moisture can degrade internal tire rubber and fail the rubber bonds which are important to durability. This is a defect in the subject tire which caused or contributed to cause this tire failure.
 - Images of ply cord shadows on innerliners compared with Dennis Carlson support my opinion as to the appearance of cord shadows in the subject failed tire.
 - The inspection of the LR and RR companion Kumho tires further supports this opinion in that they each demonstrated cord shadows on their innerliners.
5. The subject Kumho tire exhibits a low top belt width to tread width ratio. This low ratio produces increased stress and strain at the belt edge region of the tire. This is a defect which caused or contributed to cause this tire failure.
 - This opinion is also supported by the testimony of Leonard Kopka, design corporate representative of Michelin North America.

6. The subject Kumho tire's nylon cap ply configuration failed to achieve its designed function of reducing the propensity for a tread separation. There were design options available to Kumho to enhance tire durability by adding additional nylon coverage to the steel belts, whether in adding a nylon edge strip over the full nylon cap ply or adding a second layer of nylon cap ply for this Load Range E light truck application. This is a design defect which caused or contributed to cause this tire failure.
 - This opinion is also supported by the FEA analysis and peer reviewed paper conducted by Don Lee entitled, "Design Elements of Steel Belted Radial Tires to Improve Belt Durability."
 - This opinion is further supported by the testimony of Xue and Zhou in the case of [REDACTED], the design change made in the post-recall Load Range E Hercules tire, and endurance and peel strength testing conducted by me or at my request in the [REDACTED] tread separation failure case.
7. The shearographs conducted of the LR and RR companion tires support my opinions in this matter regarding the subject tire as they indicate that these two Kumho tires were also experiencing belt edge separation.

ELIMINATION OF OTHER CAUSES

As part of my standard methodology and the accepted methodology in the tire industry, I also evaluated other potential or alternative causes (or theories of causation I have become familiar with through litigation) for the tire failure other than the manufacturing or designed defects described above. I considered the following:

1. Whether there may have been an impact that may have caused this failure. I observed:
 - It is not generally accepted in the tire community that impact damage can cause the specific form of tire failure known as tread separation especially with a separation that grew over time and where the tread detached many miles after the alleged impact. There are no authoritative tests or literature on the subject of impacts causing such tread separation. In fact, after consultation with industry groups offering test protocols for tire impact/tread separation evaluation the government's National Highway Traffic Safety Administration (NHTSA) tested and concluded the protocols were inadequate at the present time. The subject tire undoubtedly suffered a tread separation. Therefore, it is extremely unlikely—from a general proposition—that the subject tire suffered its failure as the result impact damage.
 - [*Impact Simulations in the Lab*, by G.C. Bolden, J.M. Smith, R.T. Flood, Standard Testing Laboratories. “Typical impact damage on a steel belted radial passenger tire takes the form of fractured body ply cords. These fractures typically occur in the crown area and run circumferentially. Thus, to date, the research we have undertaken was unable to create partial damage to the steel belts, such as a localized fracture of the steel cables in only one belt. The testing data generated thus far indicates that the steel belts of a radial passenger tire function as a unit, whereby one belt supports the other. Within the limits of their test protocol, if steel cables are broken they usually break in both belts, resulting in immediate tire failure.”]
 - [*Alliance of Automobile Manufacturers Association Comments on NHTSA Docket 8011, 5 June 2002*, “The SAE 31981 test was developed for wheel testing, not for tire testing. The proposed test does not generally produce tire damage, and does not relate to any on-road field experience for tread or sidewall failures. The agency also did not test a wide variety of tire sizes prior to proposing the test. The test does not take into account the importance of wheel stiffness, and does not include a tiled pendulum striker.”]
 - [*Rubber Manufacturers Association Comments on NHTSA Docket 8011, 5 June 2002*, “The tire complaints that led ultimately to the TREAD ACT were related to isolated tread/belt detachment issues – not to pothole damage complaints. Damage from pothole impacts occur more frequently on the small height and aspect ratio tires and is, as ODI has ruled in recent cases, generally not

safety related. ... The SAE J1981 test was developed as a wheel damage test and has very limited use or experience within the industry as a tire test and significant work will be required to develop it into a tire test.”]

Given my observations, it is my opinion that impact played no role in the tread separation of this tire, eliminating impact as a causal factor in the failure of this tire. Impacts should be foreseeable events for a prudent tire manufacturer.

2. Whether under-inflation, over-inflation, or over-loading caused this failure. I observed:

- Rim grooving in the bead flange area, although in my experience and through my recent testing it is my observation that even under completely known conditions of load and inflation pressure, tires mounted on rims and subjected to load and inflation and driven typically produce some degree of rim impression. The rim grooves in the subject tire were dimensionally consistent with that of many other tires that can be observed in service, as well as tires I have tested.

Given my observations, it is my opinion that under-inflation or over-deflection played no role in the tread separation of this tire. Under-inflation should be a foreseeable event for a prudent tire manufacturer.

No punctures or repairs through the subject tire’s carcass.

No bead damage.

The LR and RR companion Kumho tires have internal indications of belt separations as evaluated by shearography.

SUMMARY OF OPINIONS

1. The subject tire exhibits inadequate bonding between belts as evidenced by trapped air/steam blister impressions on the separated surfaces. These are manufacturing defects.
 2. The subject tire exhibits premature oxidation of the belt skims. This is a defect in the subject tire absent outside causations.
 3. The subject tire exhibits belting defects. These are manufacturing defects.
 4. The subject tire exhibits cord shadows on the innerliner. These represent a defect.
 5. The subject tire exhibits a low top belt width to tread width ratio. This is a design defect.
 6. The subject tire exhibits an inadequate application of nylon cap plies to ensure the tire against premature fatigue failure. This is a design defect.
 7. The combination of the above stated defects caused or contributed to cause the subject tire to suffer a catastrophic tread separation failure.
-
9. While testing two new exemplar Kumho Road Venture A/T tires, both failed in sidewall failure mode in approximately 10,000 miles or less under proper loads, inflations, and speeds which were monitored daily.
 10. Shearographs taken of the LR and RR Companion tires indicating separations within those tires at the belt edges support my opinions regarding the subject tire's defectiveness.

SAFER, ALTERNATIVE DESIGNS

With respect to manufacturing defects mentioned, there were safer, alternatives in the manufacturing processes and know-how available to Kumho at the time the subject tire was produced. These meet the litmus test of being both economically and technologically feasible for a tire manufacturer. Had these safer, alternatives been employed in the manufacture of the subject tire they would have either eliminated or significantly reduced the likelihood for failure in the observed mode.

These safer, alternatives include, but are not limited to:

- Better consolidation of components—remove trapped air.
- Increased innerliner gauge.
- Improved chemical AO package in the belt skim rubber to resist premature oxidation.
- Better placement of belt materials.
- Increased belt widths.
- Additional nylon cap ply material.

The inherent weaknesses and defects as described above in this tire caused or contributed to cause its failure, and therefore a combination of alternative measures were warranted to elevate the tires overall endurance and prevent failure.

The above are my stated opinions regarding this incident tire and the materials and information made available to me at the time of my evaluation. Those materials include the subject tire and rim, companion tires and rims, X-rays, the accident report, photographs, my training, and various experiences with tire designs and efforts to improve performances based on analysis of test results and failure analysis, my education, and articles, studies, publications read, and tires I have personally inspected. Additional opinions, observations, and conclusions are stated elsewhere in this report.

This report is based upon my experiences with product development and failure analysis.

I reserve the right to supplement findings and opinions expressed in this report should information be produced through discovery by Kumho in this case about Kumho Road Venture A/T tires (or sister tires to the Road Venture A/T), additional tire materials or documents related to other similar instances of Kumho tire failures.

Depending upon the opinions offered by Kumho's experts, I reserve the right to rebut any opinions provided on behalf of the defendants. All of my opinions above are to a reasonable degree of tire engineering and scientific certainty.

Troy W. Cottles

Resume

Forensic Tire Failure Analyst

Tire Design and Manufacturing Consultant:

(7/2005 – present)

Education:

Bachelors of Science, Mathematics/Physics minor, Athens St. University, 1988.

Mechanical Engineering Study, University of AL Huntsville

Additional Training:

3-month design study with Sumitomo Rubber Ind., Ltd. Kobe, Japan

MSOffice Suite; MSProject; AutoCad; Taguchi Techniques (DOE)

Management Skills for Engineers

Design Failure Mode and Effects Analysis (DFMEA)

Technical Focus:

My 17 years of experience in the tire and rubber industry culminated with a promotion to the position of technical director of tire development for Goodyear-Dunlop Tires N.A. Ltd. I provided direct technical input into products specific to passenger and light truck OE products from 1997 onward and most recently, OE and aftermarket lines of ATV products (both bias ply and radial constructions).

Professional Experience:

Goodyear-Dunlop Tires N.A., Ltd. (Buffalo, NY)

Technical Director

(6/2005 to 7/2005)

- Responsible for all joint venture development programs (motorcycle, ATV, passenger).
- Responsible for meeting annual financial goals through product development management and cost improvements.
- Administration of the annual divisional capital and expenditure budgets.
- Negotiating technical support for outsourcing ATV products.
- Initiated technology thrusts for ATV products, including innovative ply and belt materials.
- Supporting OEM commitments through inter-company prioritization.
- Technical support on product liability issues (review claim tires, provide documentation and drawings, interpret technical specifications, and provide background on original design requirements).

Goodyear-Dunlop Tire N.A., Ltd. (Buffalo, NY)

Senior Technical Manager

(1/2003 to 6/2005)

- Responsible for ATV and OEM passenger program activities.
- Product integrity test laboratory. Testing including: endurance, regulatory, and force/moment measurement.

- Achievement of annual financial goals through product development, cost improvement efforts.
- Guidance/countermeasures for product performance improvements as required per internal, regulatory, or customer standards.

Goodyear-Dunlop Tire N.A., Ltd. (Akron, OH)

Senior Manager-OEM Passenger Development

(8/2001 to 1/2003)

- Integration of the OE passenger technical development team of Dunlop Tire Corp. into Goodyear Tire and Rubber Company's technical headquarters in Akron, OH.
- Responsible for OEM passenger/light truck tire design programs in support of Toyota and Honda per scope of the joint venture.
- Manage an annual departmental budget, including cash flow.
- Departmental staffing, annual performance reviews, and associate training.
- Conduct program kickoff meetings and design reviews with Sumitomo, OEM, and internal management in compliance with TS standards.
- Responsible for profitability of all OEM production programs.
- Formulation of countermeasures for any in-service product concerns.

Goodyear-Dunlop Tire N.A., Ltd. (Huntsville, AL)

Senior Manager-OEM Engineering

(9/1999 to 8/2001)

- Responsible for OEM passenger/light truck tire design programs for Mercedes, Toyota, Nissan, and Honda.
- Supervision of development engineering, CATIA support staff, Detroit liaison office, and inventory control personnel.
- Manage an annual departmental budget, including cash flow.
- Introduction (by presentation) of new technologies to technical executive management of all OEM customers.
- Departmental staffing, annual performance reviews and associate training.
- Global negotiation with counterparts regarding technical roles for OE business based in Japan, Europe, or North America (semi-annual to quarterly meetings overseas).
- Formulation of countermeasures for any in-service product concerns.

Dunlop Tire Corporation (Huntsville, AL)

Senior Manager-OEM Engineering

(10/1997 to 9/1999)

- Responsible for OEM passenger/light truck tire design programs for Mercedes, Toyota, Nissan, and Honda.
- Supervision of development engineering, CATIA support staff, Detroit liaison office, and inventory control personnel.
- Manage an annual departmental budget, including cash flow.
- Introduction (by presentation) of new technologies to technical executive management of all OEM customers.
- Departmental staffing, annual performance reviews and associate training.
- Global negotiation with counterparts regarding technical roles for OE business based in Japan, Europe, or North America (semi-annual to quarterly meetings overseas).
- Formulation of countermeasures for any in-service product concerns.

Dunlop Tire Corporation (Huntsville, AL)

OEM Senior Development Engineer

(8/1996 to 10/1997)

- Responsible for all Dunlop N. American OEM tire development program technical activities.
- Customer interface for technical issues.

Dunlop Tire Corporation (Los Angeles, CA)

Customer Liaison Manager

(11/1994 to 8/1996)

- Technical and field service representative to Japanese OEM R&D and service organizations.
- Negotiation of field service policies with customer corporate service management groups.
- Inspection of field returns at regional and corporate customer sites. Determination on legitimacy of claims.
- Organization of field tire surveys, JDPower roundtable conferences, and auto show surveys.
- Technical representative to FAA (Long Beach) on regulatory requirements for new aircraft tire submissions on Boeing 777 and Lockheed programs for Sumitomo Rubber Industries.

Dunlop Tire Corporation (Huntsville, AL)

OEM Design Engineer

(7/1988 to 11/1994)

- Program development support to Japanese automotive manufacturers.
- Preparation of CAD tire design drawings, manufacturing specifications, and tire designs.

Steelcase Inc. (Athens, AL)

Production Operator

(1987 to 1988)

- Manufacturing of office equipment.

Midsouth Testing, Inc. (Decatur, AL)

Waste Water System Operator

(1986 to 1987)

- Titration of industrial waste water to eliminate metals.
- System repair and maintenance.

Eaton Corporation (Athens, AL)

Engineering Technician

(1984 to 1986)

- Prototype engineering of electromechanical temperature control switches.
- Process engineering improvements—new raw material certification.
- Product engineering—environmental laboratory and field verification testing.

Cottles Consulting Inc.

Tire Design Consultant

Tire Failure Analyst

Send evidence to: 21848 East Limestone Rd., Toney, AL 35773
Send correspondence/mail to: 25884 Katpaugh Lane, Toney, AL 35773

Office: PH/FAX 256-444-0854

Cell: 256-777-0562

tcottles@mchsi.com

Fed ID # 26-1752146

Fee Schedule

- **Effective:** Jan. 1, 2015
- **Min. Non-Refundable Retainer:** \$5000--Required at time of inspection for subject tire.
- **Standard rate:** \$450/hour (Additional inspections, analysis, reports, research, teleconferences, and all other, except as noted).
- **Depositions/court appearances:** \$450/hour, 4 hour minimum
- **Travel rate:** \$450/hour (door to door)
- **All Expenses**

The following testing capabilities are available:

- **Tire Durability Testing**
- **Non-contacting 2D laser profile scanning**
- **Expandable (13" to 20") tire inflation/leak detection**
- **T&RA Rim Tapes**
- **Tire X-Rays (coordinated locally for most sizes)**

1. Payment is due upon receipt of invoice.
2. Please reference invoice number on your payment.
3. After 30 days a 20% late charge may be applied for any outstanding balances.

PUBLICATIONS/PATENTS

Statement dated 06-July-2006:

I have produced a peer-reviewed article entitled “Compression Rim Grooves-An Objective Measurement Technique” presented at the HIFI Tire Technical Conference in Houston, TX on Aug. 13, 2010.

I currently have no patent submissions.

DEPOSITION TESTIMONY HISTORY

<u>Date</u>	<u>Type</u>	<u>Case</u>	<u>Venue</u>
3/21/06	Deposition		Gwinnett, GA
8/3/06	Deposition		Maricopa, AZ
1/30/07	Deposition		Montgomery, AL
2/19/07	Deposition		New Mexico
3/9/07	Deposition		Tucson, AZ
3/30/07	Deposition		USDC, OK
4/11/07	Trial		Montgomery, AL
5/30/07	Deposition		Atlanta, GA
8/23/07	Deposition		S. Carolina
9/17/07	Deposition		Florida
9/25/07	Deposition		Alabama
10/4/07	Deposition		Texas
11/13/07	Deposition		Atlanta, GA
12/4/07	Deposition		Texas
12/14/07	Deposition		New Mexico
1/4/08	Deposition		Florida
1/23/08	Deposition		Tennessee
2/1/08	Deposition		Georgia
2/13/08	Deposition		S. Carolina
2/26/08	Deposition		Texas
3/10/08	Trial		Provo, UT
3/17/08	Trial		W. Palm Beach, FL
4/8/08	Deposition		Texas
4/24/08	Deposition		Georgia
4/30/08	Deposition		Florida
5/14/08	Deposition		Texas
5/22/08	Deposition		Texas
6/19/08	Deposition		Texas
7/10/08	Deposition		Montana
7/18/08	Trial		Savannah, GA
7/24/08	Deposition		Los Angeles, CA
7/29/08	Deposition		Albuquerque, NM
8/7/08	Deposition		Albuquerque, NM
8/28/08	Deposition		Georgia
9/4/08	Deposition		Salt Lake City, UT
10/21/08	Deposition		Orlando, FL
11/4/08	Deposition		Wyoming
12/9/08	Deposition		Texas
12/19/08	Deposition		Texas
12/30/08	Deposition		Nevada
1/7/09	Deposition		Ohio

1/20/09	Deposition		Texas
2/4/09	Deposition		Florida
2/10/09	Deposition		Florida
2/18/09	Deposition		Texas
2/25/09	Deposition		Texas
3/3/09	Deposition		Texas
3/23/09	Trial		Nevada
3/31/09	Deposition		Alabama
4/14/09	Deposition		Texas
5/6/09	Deposition		Arizona
6/23/09	Deposition		Florida
7/10/09	Deposition		Florida
7/14/09	Deposition		Iowa
7/20/09	Deposition		Texas
8/27/09	Trial		Texas
8/31/09	Trial		Texas
9/9/09	Deposition		S. Carolina
9/24/09	Deposition		Georgia
10/1/09	Deposition		Texas
10/13/09	Deposition		Texas
10/21/09	Deposition		Georgia
10/22/09	Deposition		Montana
10/29/09	Deposition		Florida
11/10/09	Deposition		Texas
11/19/09	Deposition		Alabama
11/24/09	Deposition		Montana
12/1/09	Deposition		S. Carolina
12/8/09	Deposition		Arizona
12/22/09	Deposition		Florida
1/08/10	Deposition		Indiana
1/13/10	Deposition		Texas
2/3/10	Deposition		Georgia
2/16/10	Deposition		Georgia
2/22/10	Trial		Iowa
3/4/10	Deposition		Montana
3/11/10	Deposition		Georgia
3/17/10	Deposition		Florida
3/30/10	Deposition		Georgia
4/3/10	Deposition		Illinois
4/19/10	Deposition		Mississippi
5/18/10	Deposition		Illinois
5/27-28/10	Deposition		Texas
6/24-6/28/10	Trial		Montana
8/10/10	Deposition		Florida
8/20/10	Deposition		Georgia
8/24/10	Trial		Texas

8/31/10	Deposition	Texas
9/2/10	Deposition	Indiana
9/15/10	Deposition	Alabama
9/28, 29/10	Deposition	Utah
10/7/10	Deposition	Texas
10/18/10	Hearing	Texas
10/19, 20/10	Trial	Texas
10/29/10	Deposition	Texas
11/2/10	Deposition	Florida
11/9/10	Deposition	S. Carolina
11/18/10	Deposition	Arizona
12/1/10	Deposition	Nebraska
12/16, 17/10	Deposition	Utah
1/15/11	Trial	Arizona
2/23/11	Deposition	Georgia
3/18/11	Deposition	Mississippi
3/23/11	Deposition	Texas
3/29/11	Deposition	Kentucky
5/10/11	Deposition	Texas
5/13/11	Deposition	Georgia
5/20/11	Deposition	Alabama
5/25/11	Deposition	Oklahoma
8/16/11	Deposition	Georgia
8/19/11	Deposition	California
8/25/11	Deposition	California
8/31/11	Deposition	Texas
9/16/11	Deposition	S. Carolina
10/13/11	Deposition	Georgia
11/9/11	Deposition	Florida
11/20, 21/11	Hearing	Florida
11/28/11	Deposition	Mississippi
12/9/11	Deposition	Michigan
12/14/11	Deposition	Georgia
1/13/12	Deposition	California
1/18/12	Deposition	Mississippi
3/15/12	Deposition	California
4/5/12	Deposition	Texas
4/10/12	Trial	Kentucky
4/13/12	Deposition	Texas
4/18,19/12	Trial	Montana
5/1/2012	Deposition	California
6/11/12	Deposition	California
7/12,13/12	Trial	Texas
7/18/12	Deposition	USVI
8/2/12	Deposition	S. C.
8/7/12	Deposition	Florida

8/10/12	Deposition		Texas
8/15/12	Deposition		Florida
8/21/12	Deposition		Mississippi
9/04/12	Deposition		Texas
9/18/12	Deposition		S.C.
9/21/12	Deposition		Texas
10/16/12	Trial		Alabama
10/19/12	Deposition		Florida
10/23/12	Deposition		California
10/24/12	Deposition		California
11/8,9/12	Trial		Texas
11/13/12	Deposition		Illinois
11/16/12	Deposition		Alabama
11/20/12	Deposition		Georgia
11/27/12	Deposition		Texas
1/10/13	Deposition		Florida
2/5/13	Trial		California
2/15/13	Deposition		Alabama
2/26/13	Deposition		Alabama
3/8/13	Deposition		Florida
3/18/13	Deposition		California
4/2/13	Hearing		Florida
4/4/13	Trial		Florida
4/9/13	Deposition		Texas
4/12/13	Deposition		Alabama
4/18,19/13	Trial		Texas
5/8/13	Deposition		Idaho
5/14/13	Deposition		Arizona
7/12/13	Deposition		Nevada
8/19/13	Deposition		Nevada
8/27/13	Deposition		Texas
8/28/13	Deposition		Texas
9/24/13	Trial		Florida
10/9/13	Deposition		California
10/18/13	Trial		California
11/6/13	Deposition		Iowa
12/5/13	Deposition		Florida
1/8/14	Deposition		S.Carolina
2/4/14	Deposition		Florida
2/13/14	Deposition		California
2/26/14	Deposition		S. Carolina
3/5/14	Deposition		Alabama
3/7/14	Deposition		Texas
4/11/14	Deposition		Florida
4/18/14	Deposition		Tennessee
4/21/14	Deposition		S.C.

5/7/14	Deposition		S.C.
5/9/14	Deposition		Texas
5/13/14	Deposition		California
5/29-30/14	Deposition		Georgia
6/4/14	Deposition		Florida
6/10/14	Deposition		IL
7/2/14	Deposition		Florida
7/21/14	Deposition		Florida
8/12/14	Deposition		Alabama
8/20/14	Deposition		Oklahoma
8/28/14	Deposition		Texas
9/2/14	Deposition		Florida
9/11/14	Deposition		Alabama
9/18/14	Deposition		Alabama
10/10/14	Deposition		Alabama
10/15/14	Deposition		Alabama
10/24/14	Deposition		Florida
11/05/14	Deposition		Alabama
11/11/14	Deposition		Texas
1/06/15	Deposition		California
1/09/15	Deposition		Texas
1/22/15	Deposition		Florida
1/28/15	Deposition		Georgia
1/30/15	Deposition		Alabama

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APPENDIX

Nylon Cap Plies (Reinforcement):

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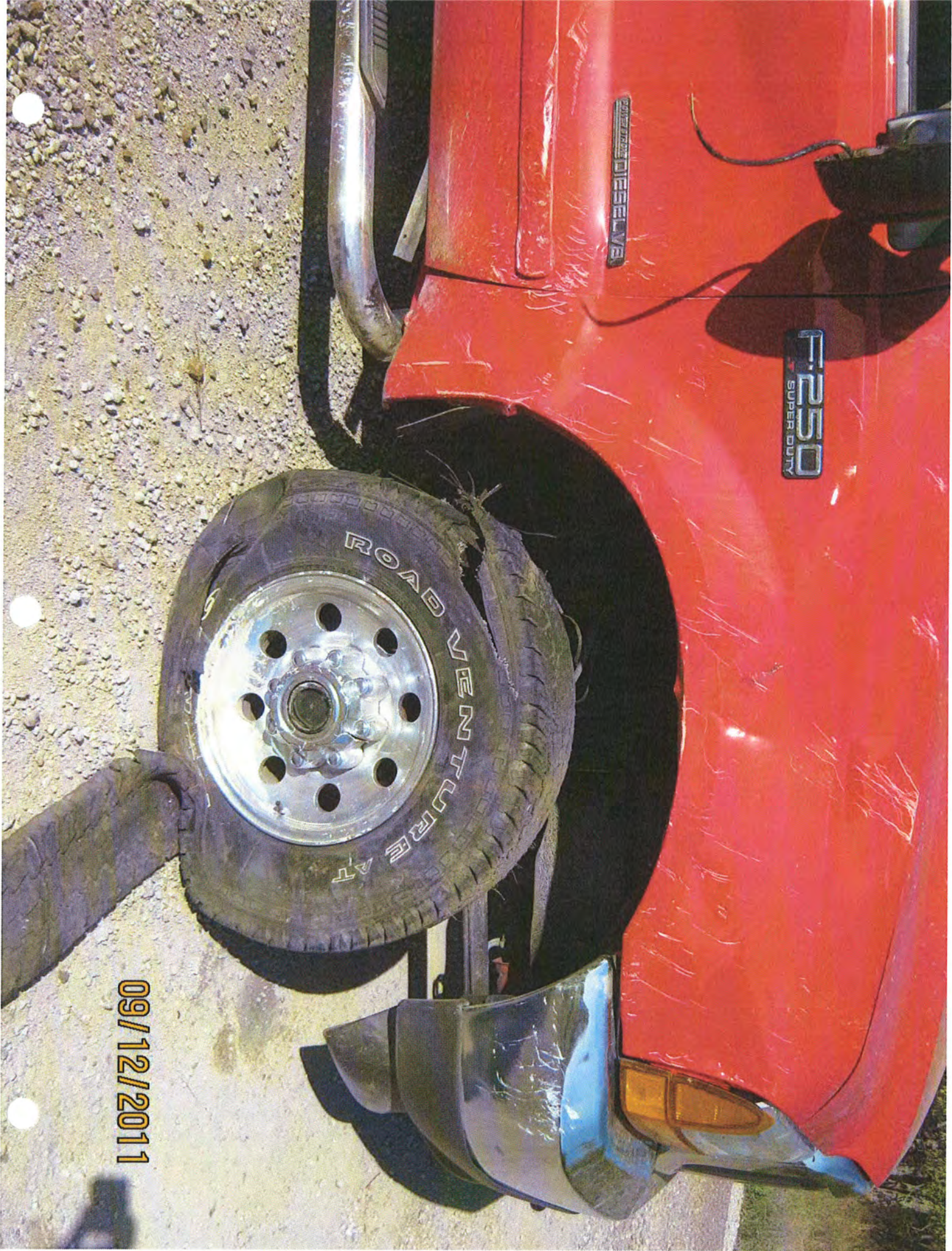
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Rubber Penetration of steel belt cabling:

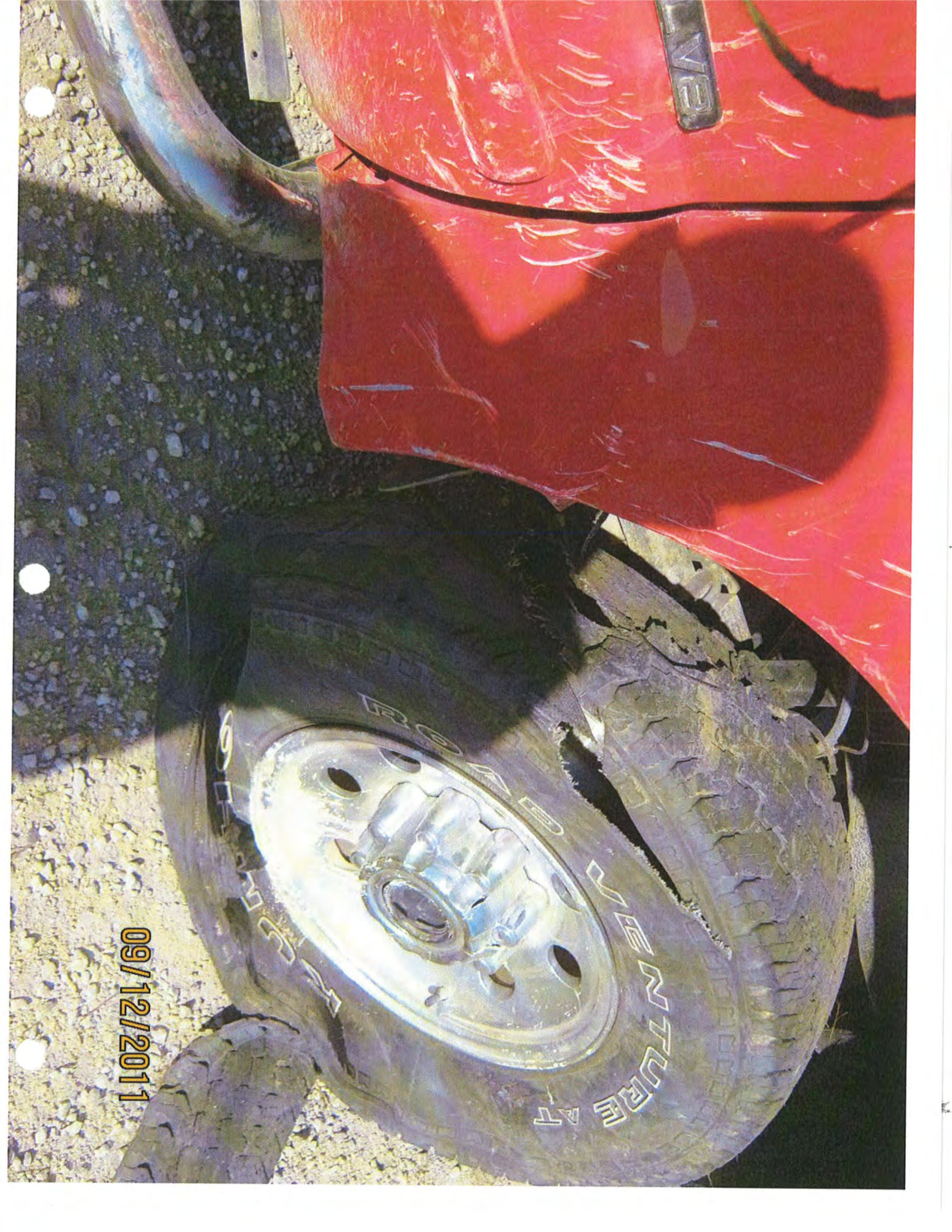
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