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Mechanical Analysis of Agricultural Failures

Presented by: Marc A. Cammack, P.E., Senior Consultant

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Senior Consultant Marc Cammack is a forensic engineer with more than 15 years of experience in custom design, manufacturing, maintenance, project management, and engineering consultation. He is a registered professional mechanical engineer in four states, as well as a Certified Fire and Explosion Investigator, a Certified Vehicle Fire Investigator, and an ASE (Automotive Service Excellence) Certified Master Automobile Technician. He also holds certifications as an Accident Reconstruction 2 expert, Traffic Investigation 1 & 2 expert, and Bosch CDR Technician. His skills are focused on plumbing system components and analysis, failures, and fires relating to passenger cars, trucks, buses, utility vehicles, agricultural, construction, and industrial equipment. Mr. Cammack holds a Bachelor of Science degree in Agricultural Engineering from the University of Kentucky.

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Overview

- The unique nature of agricultural machinery losses
- Types of losses
- Investigative techniques
- Case studies

Types of Losses

- Fire losses
- Machinery failures
- Roadway accidents
- Personal injuries
- Case studies

The Unique Nature of Agricultural Failures and Losses

- Harsh, off-road, outdoor operating conditions
- No regulatory oversite for loads and operation of equipment
- Equipment may sit for extended periods of time with no use
- Many farmers perform their own maintenance
- Travel slower on roadway

The Unique Nature of Agricultural Failures and Losses

Harsh, off-road, outdoor operating conditions

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The Unique Nature of Agricultural Failures and Losses

Many farmers perform their own maintenance

6. MAINTENANCE

[1] SERVICE INTERVALS

	Interval	Item		Reference page		
A	initial 50 Hr	Engine oil	Change	G-17		
		Engine oil filter	Replace	G-17		
		Fan/Air-conditioner belt [M6-131, M6-141]	Check	G-18		
B	every 50 Hr	Engine start system	Check	G-19		
		Wheel bolt torque	Check	G-20		
		Tie-rod dust cover	Check	G-20		
C	every 100 Hr	Greasing	–	G-21		
		Air cleaner Primary element	Clean	G-24	*1	
		Fan belt [M6-101, M6-111]	Adjust	G-25		
		Brake pedal	Adjust	G-26		
		Parking brake lever	Adjust	G-26		
		Battery condition	Check	G-27	*6	
		Air conditioner drive belt [M6-101, M6-111]	Adjust	G-29		
D	every 200 Hr	Toe-in	Adjust	G-29		
		Fuel tank water	Drain	G-30		
		Inner air filter	Clean	G-30		
		Fresh air filter	Clean	G-31		
E	every 400 Hr	Fan/Air-conditioner belt [M6-131, M6-141]	Check	G-18	*4	
		Water separator	Clean	G-32		
		Fuel solenoid pump	Clean	G-33		
F	every 500 Hr	Engine oil	Change	G-17	*4	
		Engine oil filter	Replace	G-17	*4	
		Pre-Fuel filter [M6-131, M6-141]	Clean	G-34		
		Fuel filter	Replace	G-34		
		Hydraulic oil filter	Replace	G-35		
		Power steering oil line	Check	G-36	*5	
		Radiator hose and clamp	Check	G-37	*5	
		Fuel line	Check	G-38	*5	
		Intake air line	Check	G-39	*5	
		Oil cooler line	Check	G-40	*5	
		Power Shift	Adjust	G-40		
		Air conditioner pipes and hoses	Check	G-40	*5	
G	every 600 Hr	Front axle pivot	Adjust	G-41		

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Fire Losses

The most destructive type of machinery loss

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Exhaust Aftertreatment (Regen, DPF, DEF, EGR, SCR, DOC)

Implications of complexity and elevated exhaust temperatures

Emission Systems

- **DEF – Diesel Exhaust Fluid**
- **EGR – Exhaust Gas Recirculation**
- **SCR – Selective Catalytic Reduction**
- **DOC – Diesel Oxidation Catalyst**
- **DPF – Diesel Particulate Filter**

PM2.5

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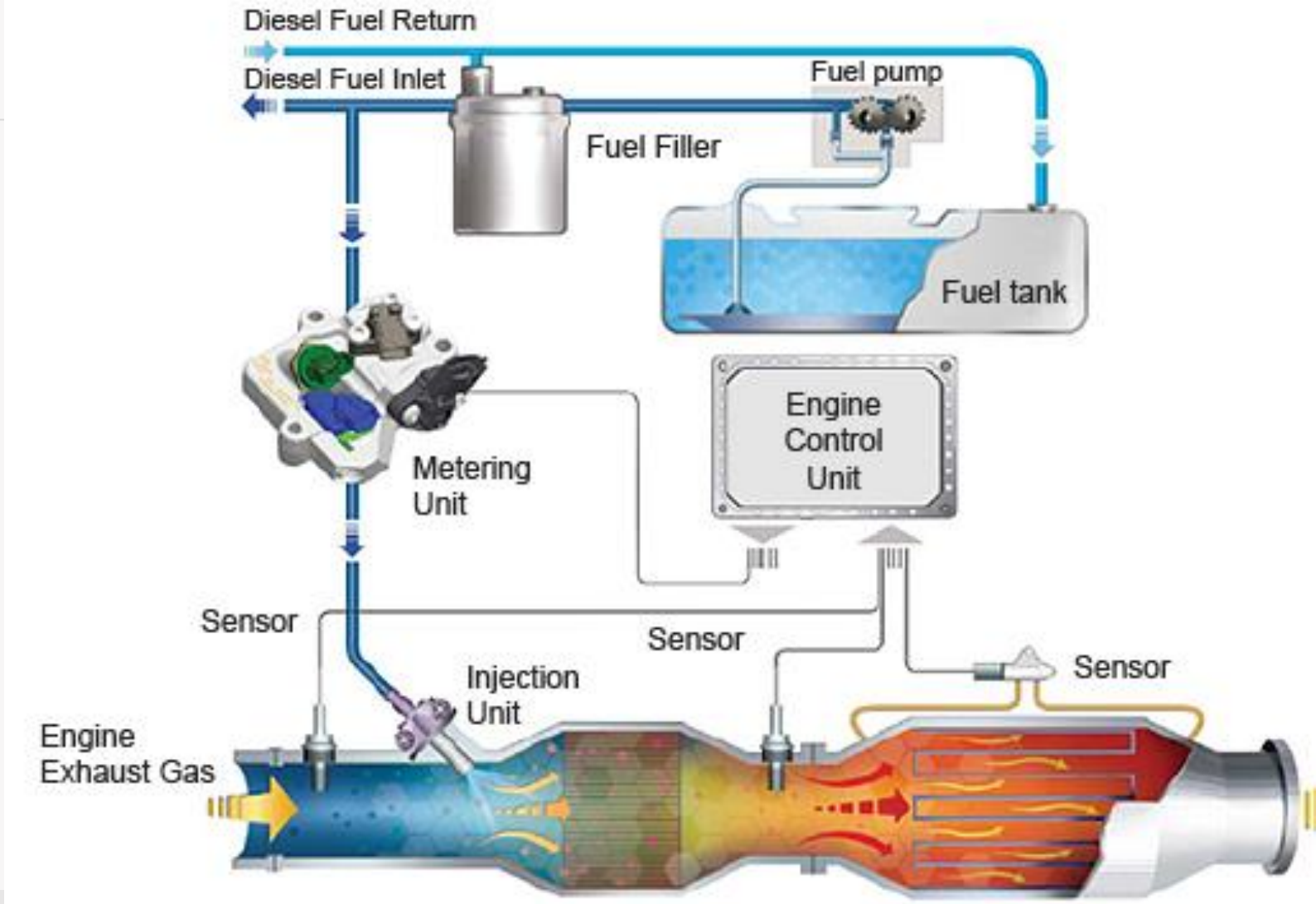
PM2.5


Diesel Fuel Return
Diesel Fuel Inlet
Fuel pump
Fuel Filler
Fuel tank
Engine
Control
Unit
Metering
Unit
Sensor
Sensor
Sensor
Injection
Unit
Engine
Exhaust Gas

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Why this discussion on emission systems?

- It is new technology that wasn't around a decade ago
- High exhaust temperatures that are generated during active regeneration
- Complexity, sensitivity, and cost to repair these systems

Machinery Failures

- Fluid contamination
- High pressure fuel system failures
- Vandalism/Sabotage

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Machinery Failures

- Mechanical failures

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- Mechanical failures

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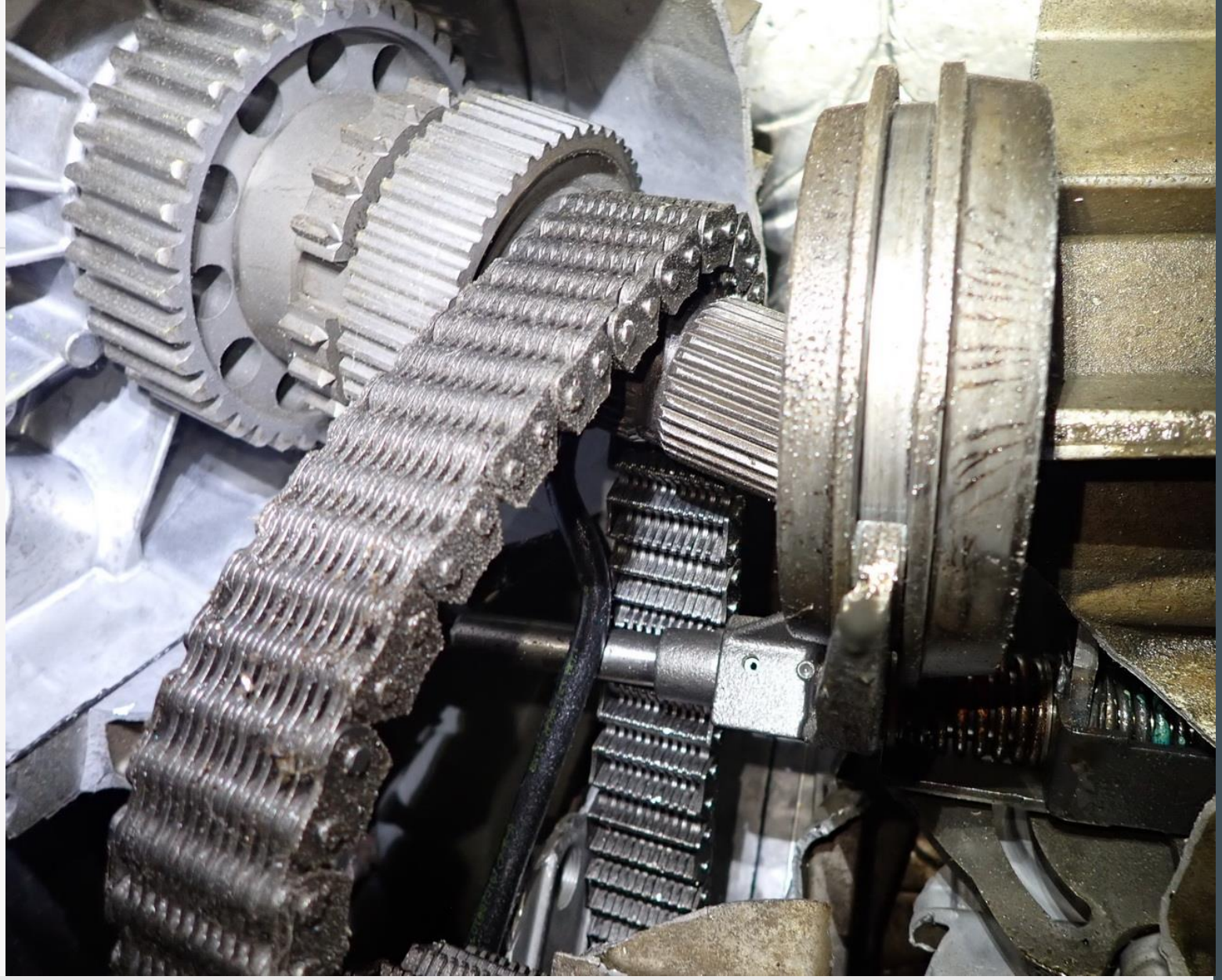
Machinery Failures

- Mechanical failures



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Machinery Failures

- Mechanical failures

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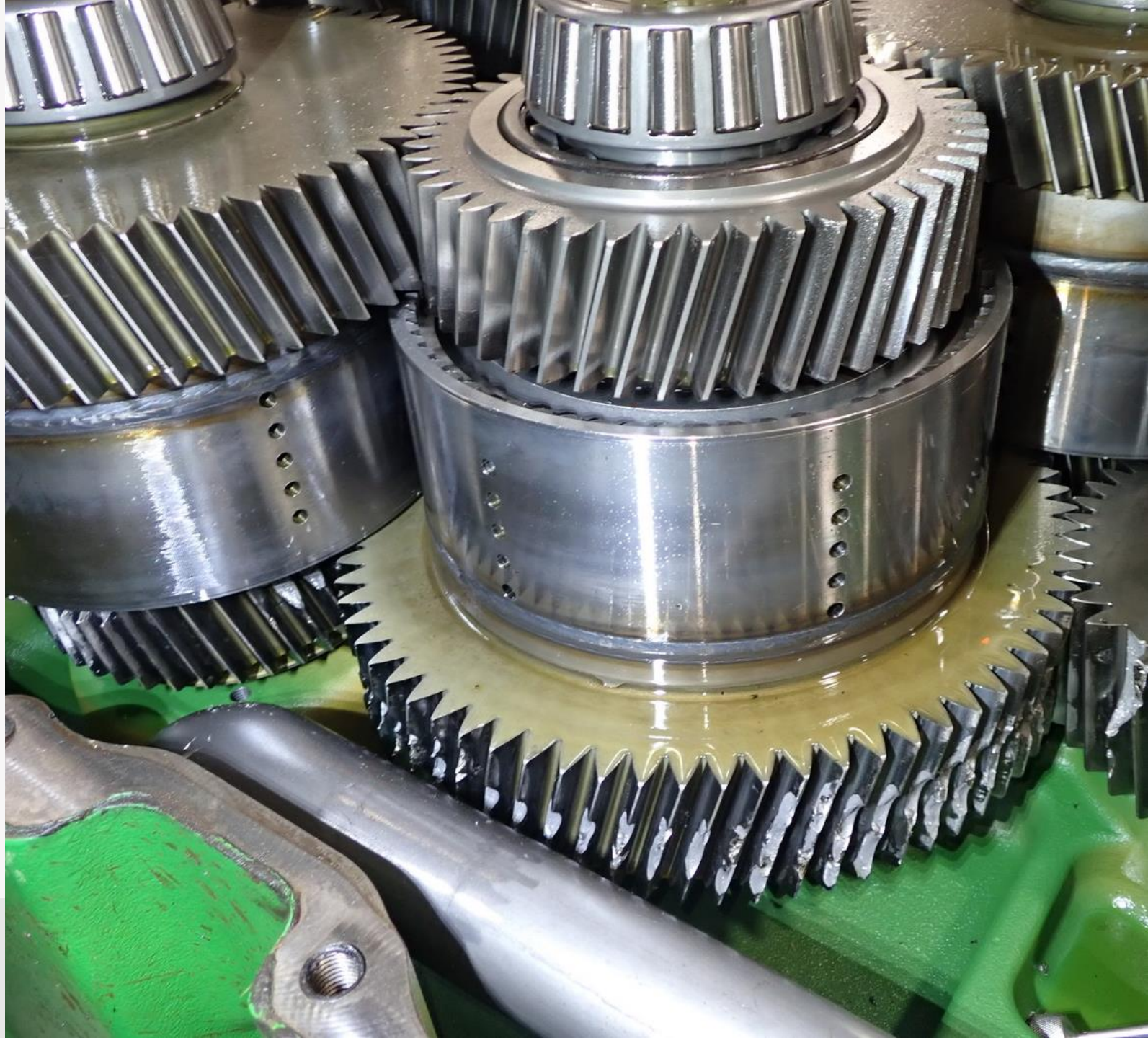
Machinery Failures Conclusion

- Accident Reconstruction
- Metallurgical Analysis
- Human Factors Analysis
- Diagnostic Data Analysis
- Fire Component Analysis
- Injury and Biomechanical Evaluation



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Machinery Failures Continued

- Reliance on Dealerships for data and diagnostic equipment

Personal Injuries and Accidents

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Questions?

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