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Design Improvements to General Service Tank Cars

FRA Region 7 Hazmat Seminar

Lawrence H. Strouse P.E.

June 25 - 27, 2013

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DOT Safety Policy

DEPARTMENT OF TRANSPORTATION
UNITED STATES OF AMERICA

POLICY STATEMENT ON SAFETY 2011

In carrying out our transportation mission, safety is our highest priority. Every life is precious, and we must strive to ensure the safety of every user of our transportation systems, as well as all who are affected by those systems. Injuries and loss of life are unacceptable in the efficient and effective transportation of goods and people, and we must take every practical action to prevent those tragedies from happening.

The American public has entrusted us with the responsibility of assuring the safety of our transportation systems. We will hold ourselves accountable, measure our performance, and continuously act to make our transportation systems safer. We expect no less from our transportation partners. Our guidance, oversight, and regulatory decisions will emphasize safety and be timely, fair, reasonable, and necessary. We can and should be a change agent by exemplifying and promoting a safety culture in which the values, actions, and behaviors of our employees reflect this priority.

Safety begins within our own Department, and the ability to carry out our statutory responsibilities is directly tied to the health and wellbeing of our workforce. The safety of our own employees is paramount. Each of our employees should be provided with a safe working environment, and know how to respond to emergencies and avoid unnecessary risks. We also expect supervisors and managers to provide our employees with an environment that promotes the open sharing of safety concerns, without fear of reprisal, as well as processes to assure those concerns are addressed. It is the responsibility of all DOT employees to conduct themselves in a way that does not pose unnecessary risks, or put themselves or others in danger.

Everyone within the Department is expected to exercise effective leadership in support of this policy, which shall be posted throughout the Department, clearly visible and accessible to all employees.

Ray LaHood

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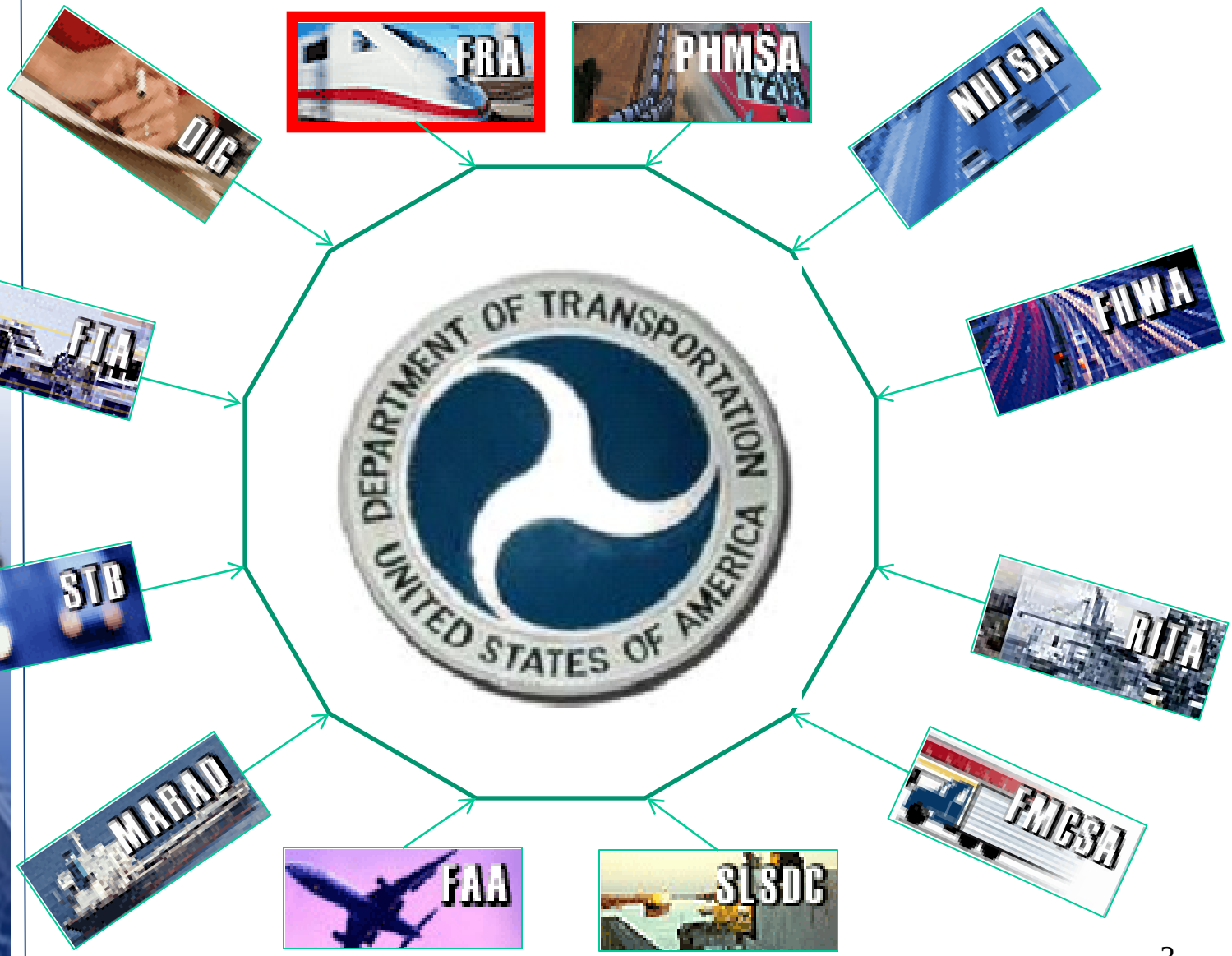
Who Is FRA



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Who Is FRA

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Vancouver Region 8

Kansas City Region 6

Chicago Region 4

Philadelphia Region 2

Cambridge Region 1

Sacramento Region 7

Washington, DC Headquarters

Atlanta Region 3

Ft. Worth Region 5

AK WA OR CA ID NV MT WY UT AZ CO NM ND SD NE KS OK TX MN IA MO AR LA WI IL MI IN KY TN MS AL GA FL SC NC OH WV VA PA NY MD DE NJ CT RI MA VT NH ME

415	FRA Safety Inspectors Nationwide
350	FRA Support & Analysis Staff
160	State Inspectors – 30 States

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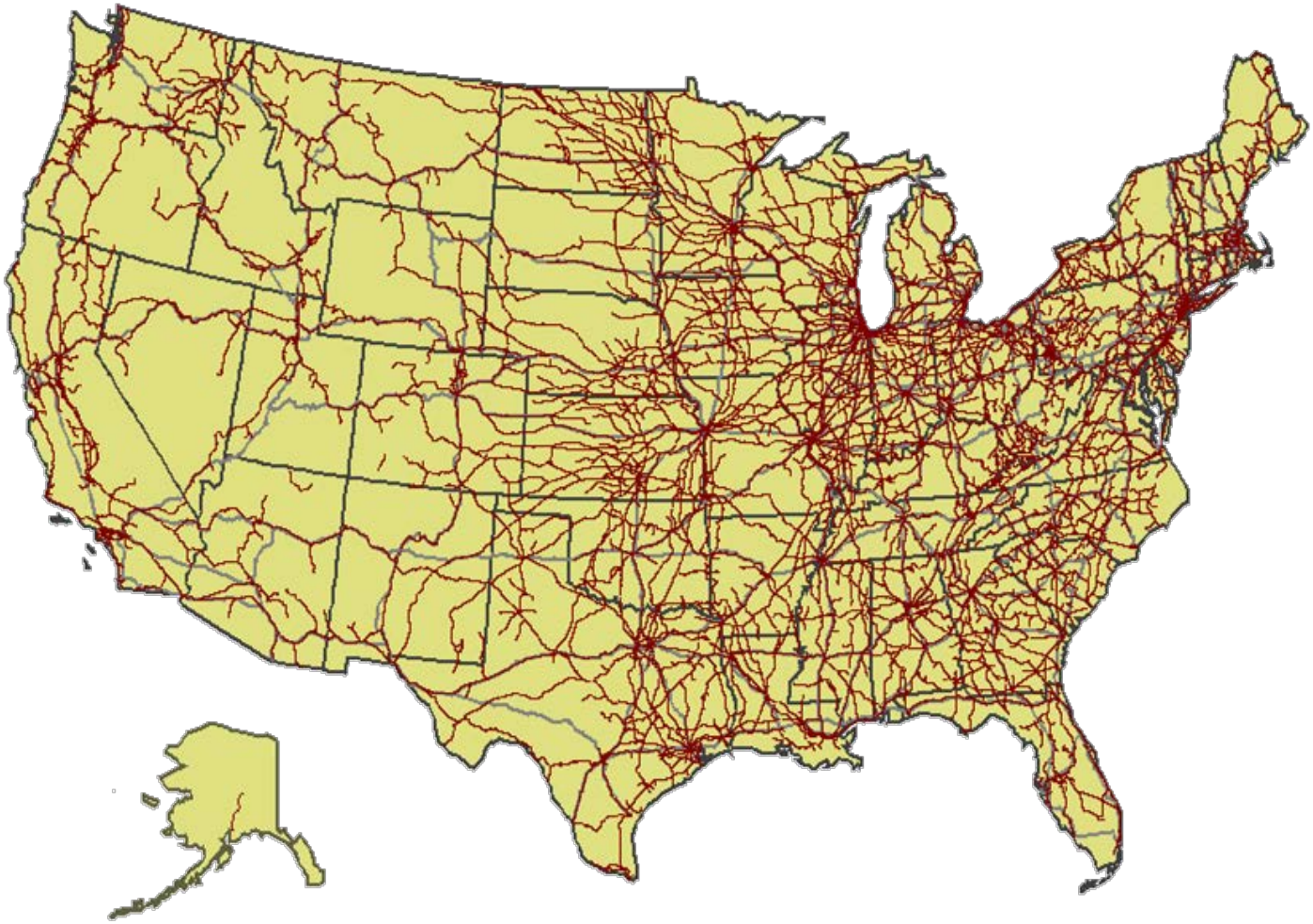
U.S. Rail Network Map



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Learning Objectives

- Who is FRA
- Review DOT Safety Policy
- Understand Federal Expectations for Tank Cars
- Review Design Improvements
- Reliability
- Where We're Headed

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Tank Car Safety Through

"Specification"

"Design"

"Manufacture"

"Maintenance"

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Ready???

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Federal Requirements in Many Industries

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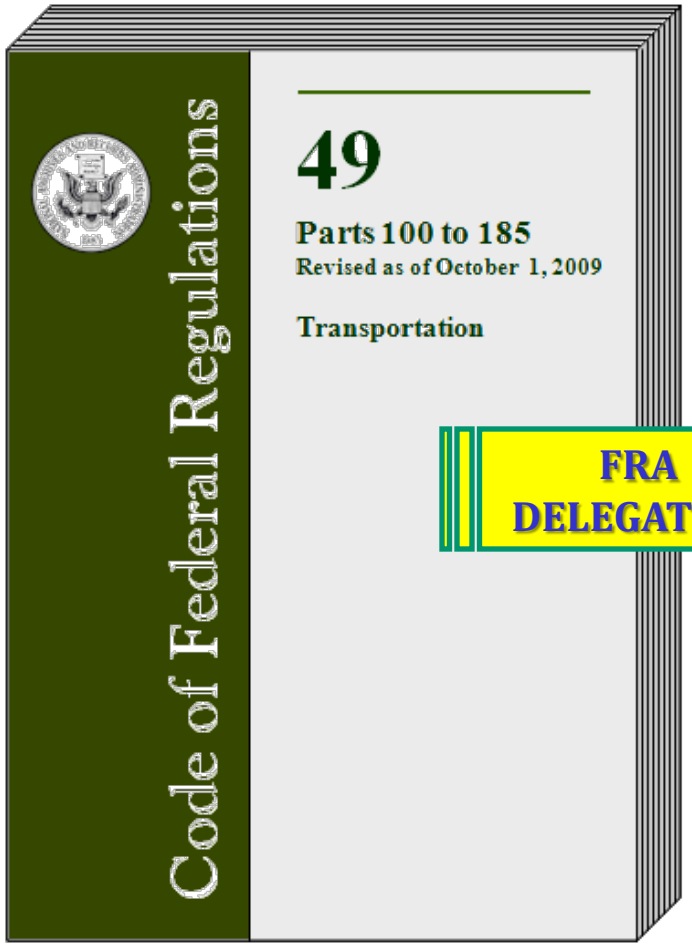
Federal Requirements for Tank Cars



FRA DELEGATION

Association of American Railroads
Safety and Operations

MANUAL OF STANDARDS
AND
RECOMMENDED PRACTICES
SECTION C-III

SPECIFICATIONS FOR TANK CARS
M-1002

Published by
The Association of American Railroads
50 F Street, N.W., Washington, D.C. 20001-1564

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Federal Expectations

Simply stated:

(1) Design it right;

(2) Make it right;

(3) Maintain it right:

(4) Catch any defects;

(5) Don’t let them happen again.

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Tank Cars Come In All Styles and Colors

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Two Types – High Pressure & General Purpose

General Purpose (GP) – Mechanical Features

- After 12/2003 - 263K+ GRL Cars
  - o Double Shelf Couplers
  - o Thicker Tank Shells (7/16" & ½" TC-128, ½" & 5/8" A516-70)
  - o Head Shields (Half or Full)
  - o Top & Bottom Fittings Protection (Appendix E10.2.1)
  - o Reclosing PRD or Equal Safety Level Non-reclosing

- After 08/2011 - Petroleum Crude Oil / Alcohols N.O.S. / Ethanol & Gasoline Mixture (CPC-1232)
  - o Thicker Tank Shells
  - o Head Shields (Half or Full)
  - o Top & Bottom Fittings Protection (Appendix E10.2.1)
  - o Reclosing Pressure Relief Devices or Equal Safety Level As Non-reclosing (with PHMSA Approval)

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"Now . . . Coming to A Town Near You!!!

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"Now . . . Coming to A Town Near You!!!

DOT-111A100W-3

	STATION STENCIL	QUALIFIED	DUE
TANK QUALIFICATION	GAHT	2005	2015
THICKNESS TEST	GAHT	2005	2015
SERVICE EQUIPMENT	GAHT	2005	2015
PRD: VALVE 75 PSI	GAHT	2005	2015
LINING:			
88.B.2 INSPECTION	GAHT	2005	2015
STUB SILL INSPECTION	GAHT	2005	2015

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Double Shelf Couplers

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Law of Unintended Consequences

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Head & Shell Protection

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Head Shields

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Head Shields

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Head Shields

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Cherry Valley, IL 06/2009

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Fittings Protection

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Top Fittings Protection - HP

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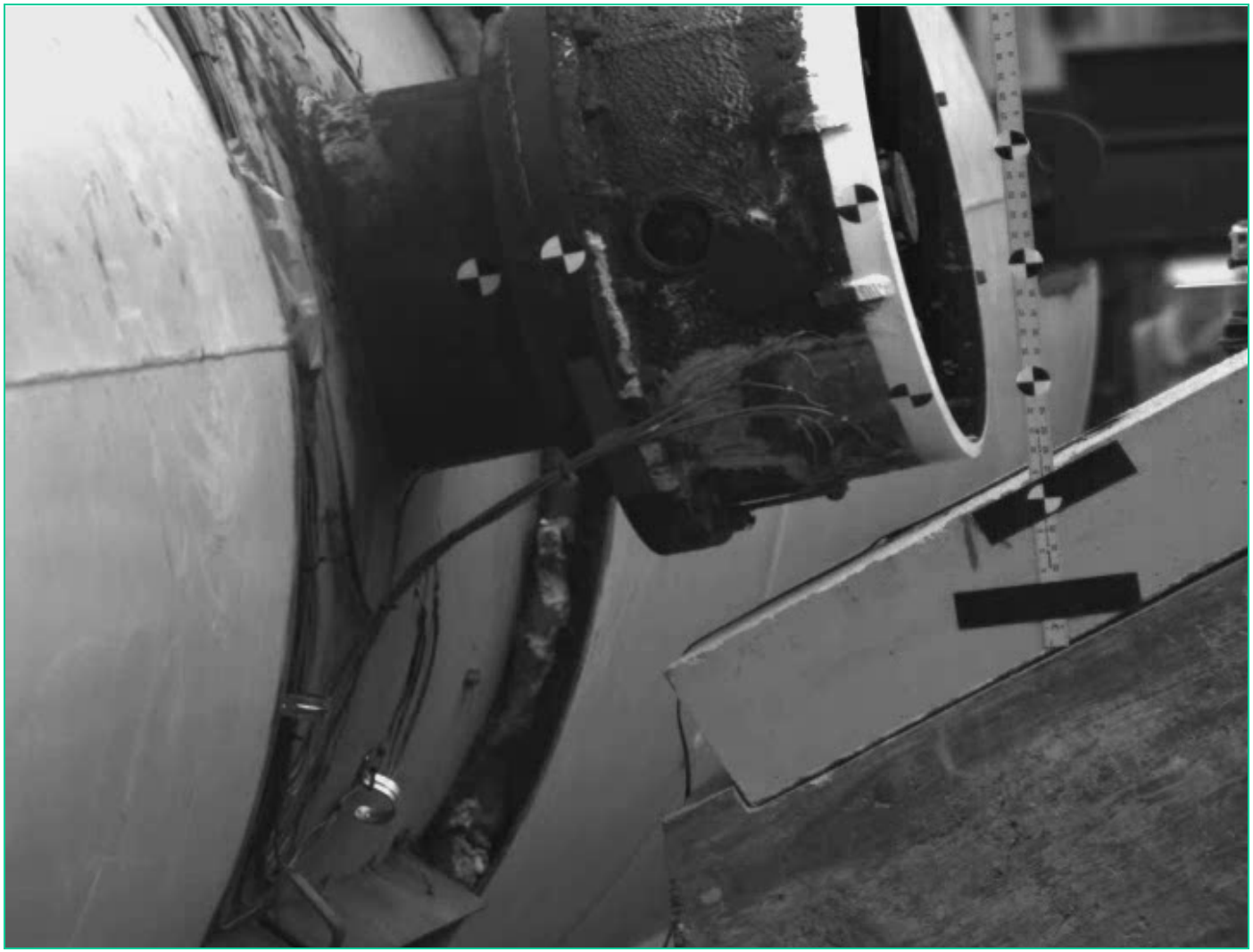
Top Fittings Protection



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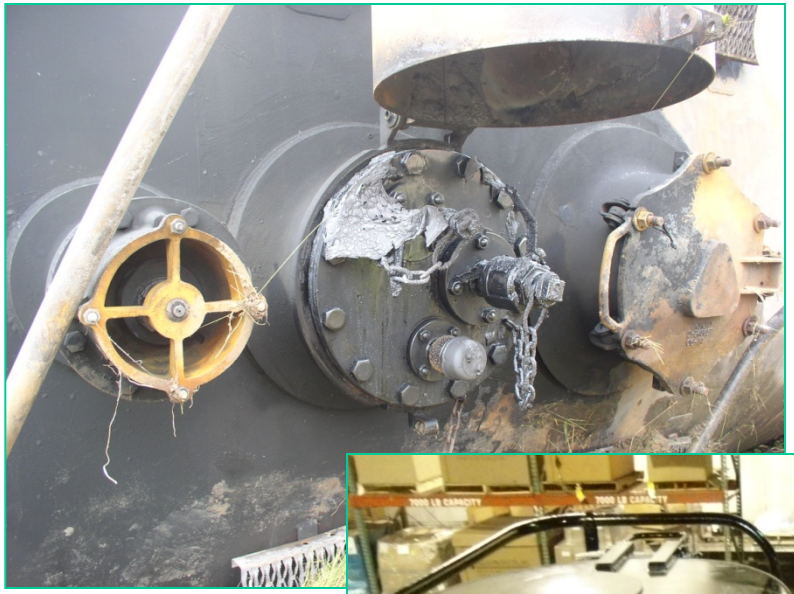
Cherry Valley, IL 06/2009



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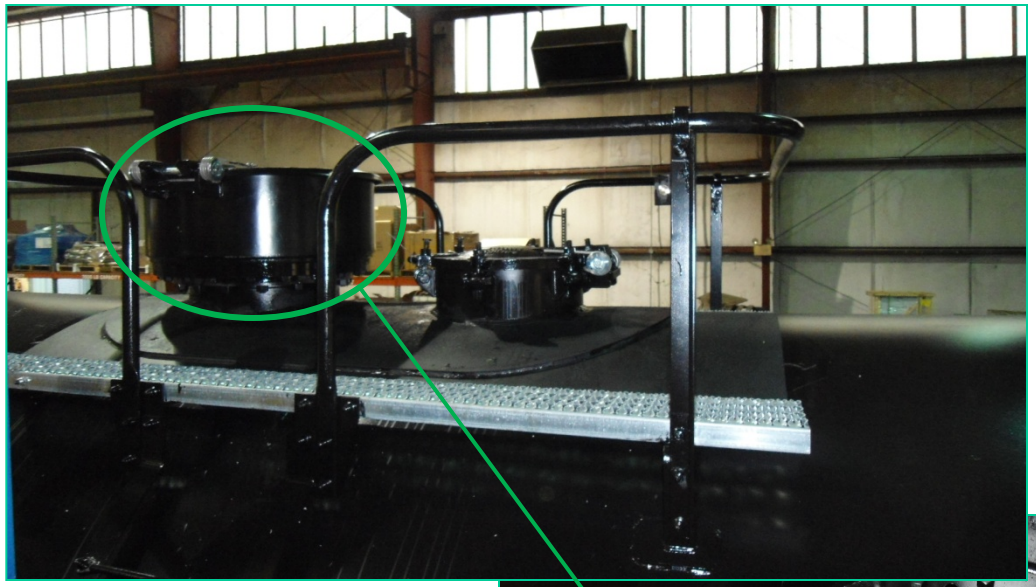
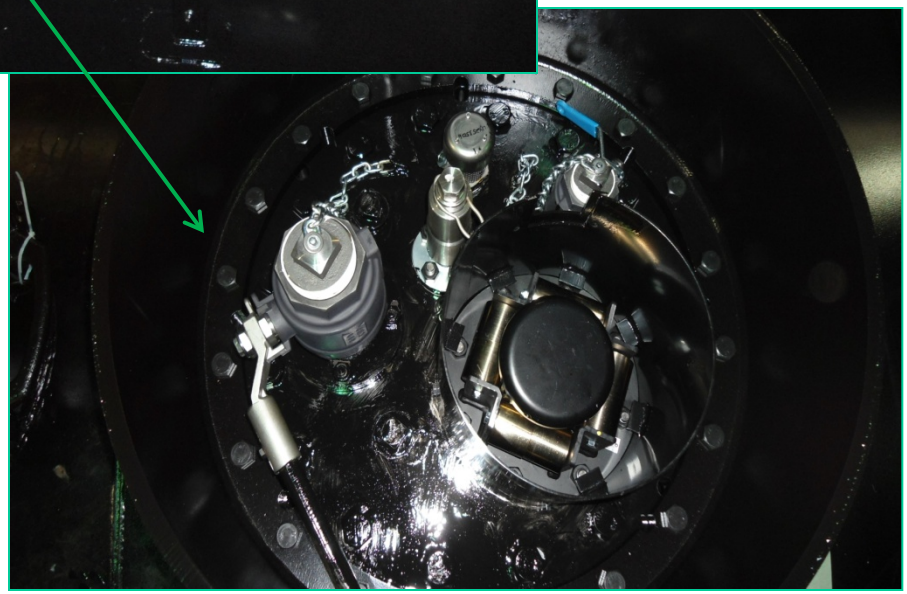
Top Fittings Protection - GP





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Head & Shell Protection

7/16” vs. ½” TC-128 Normalized = +14.3%

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Cherry Valley, IL 06/2009

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Reliability

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Quality – "Conformance to Requirements"

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Quality – "Which Car Has Better Quality?"

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Reliability and the Regulations

Reliability – "Quality Over Time"

Reliability – "Conformance to Requirements Over Time"

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Reliability – "Quality Over Time"

Reliability – The quantified ability of an item or structure to operate without failure for the specified period of its design life or until its next qualification.

Example: My car starts every day.

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Reliability – "Which Car Has Better Reliability?"

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Reliability – "Quality Over Time"

Reliability – The quantified ability of an item or structure to operate without failure for the specified period of its design life or until its next qualification.

Design Level of Reliability and Safety – The level of reliability and safety built into the tank car and, therefore, inherent in its specification, design, and manufacture.

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Frequency of Qualification & Tests (180.509)

Coatings / Linings – 180.509(i) ***Internal coating and lining inspection and test.***

(1) The owner of an internal coating or lining applied to protect a tank used to transport a material that is corrosive or reactive to the tank must ensure an inspection adequate enough to detect defects or other conditions that could **reduce the design level of reliability and safety** of the tank is performed.

(2) The owner of the internal coating or lining must use its knowledge of the service life of each coating or lining and commodity combination to establish an appropriate inspection interval for that coating or lining and commodity combination.

This interval must not exceed eight (8) years, unless the coating or lining owner can establish, document, and show that the service history or scientific analysis of the coating or lining and commodity pairing supports a longer inspection interval.

The owner must maintain at its principal place of business, and make available to FRA, a **written procedure** for **collecting and documenting the performance** of the coating or lining applied within the tank car for its service life.

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Frequency of Qualification & Tests (180.509)

Service Equipment – 180.509(k) ***Service equipment inspection and test.***

(1) Each tank car owner must ensure the qualification of tank car service equipment at least once every ten (10) years.

The tank car owner must **analyze the service equipment inspection and test results** for any given lading and, based on the analysis, adjust the inspection and test frequency to ensure that the **design level of reliability and safety** of the equipment is met.

The owner must maintain at its principal place of business, and make available to FRA, all supporting documentation used to make such analyses and inspection and test frequency adjustments.

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The owner must maintain at its principal place of business all supporting documentation used to make such analyses and inspection and test frequency adjustments.

The supporting documentation must be made available to FRA or an authorized representative of the Department upon request.

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Reliability – the "less than one failure" rule

- 99% reliability of 10 car fleet = 0.1 failed cars (< one car)
- 99% reliability of 100 car fleet = 1 failed car
- 99% reliability of 1,000 car fleet = 10 failed cars
- 99% reliability of 10,000 car fleet = 100 failed cars

Reliability specification depends entirely on failure definition

- Actual failure = loss of function = no safety margin
- Precursor failure = some safety margin depending on failure mode
- Select failure specification based on "less than one failure" rule and failure definition (allowable safety margin)

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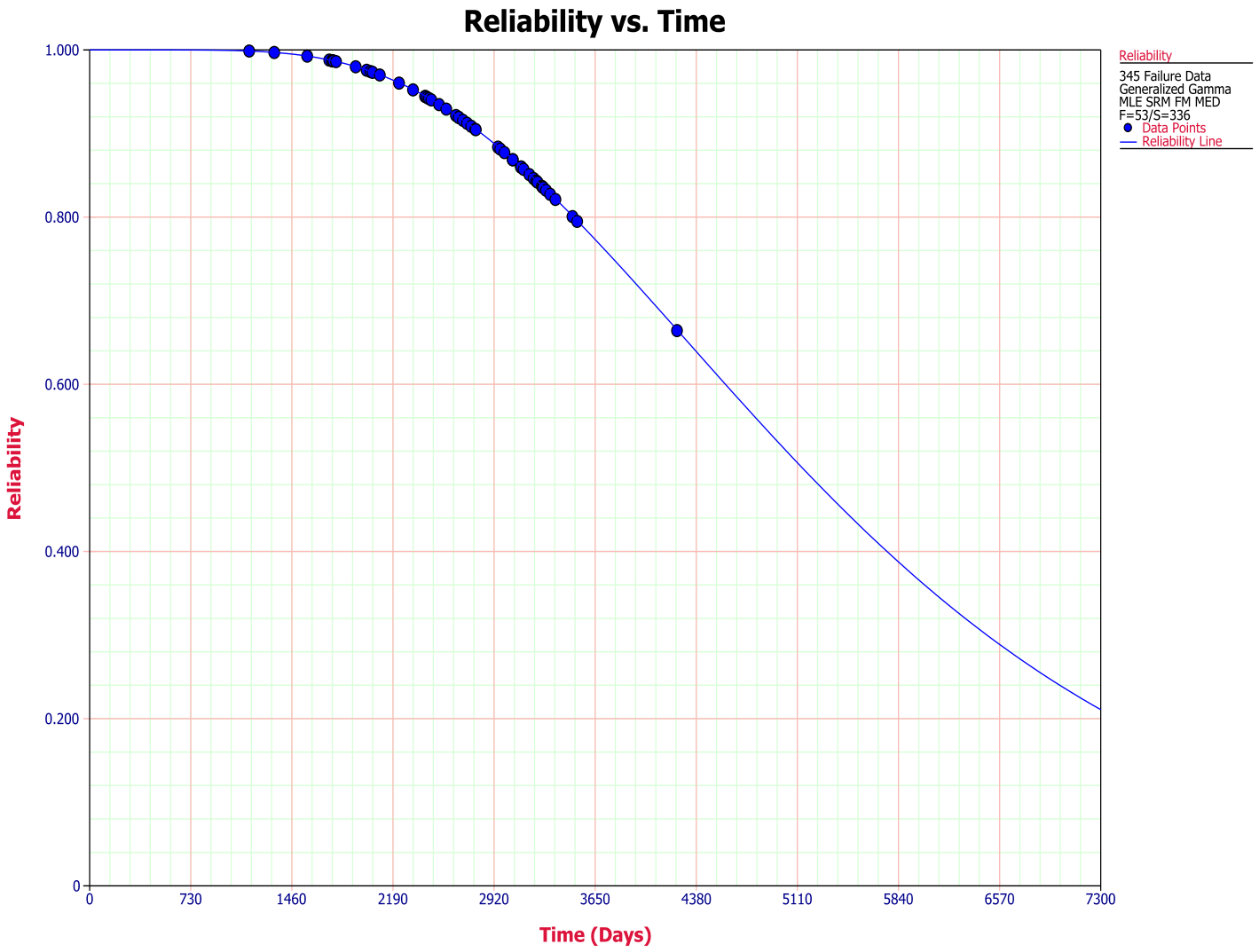

Mu=8.575351, Sigma=0.444405, Lambda=0.198147

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Mu=8.470493, Sigma=0.268959, Lambda=0.791117, Rho=0.994303

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2345 Failure Data: Mu=8.4705, Sigma=0.2690, Lambda=0.7911, Rho=0.9943
345 Failure Data: Mu=8.5735, Sigma=0.4444, Lambda=0.1981

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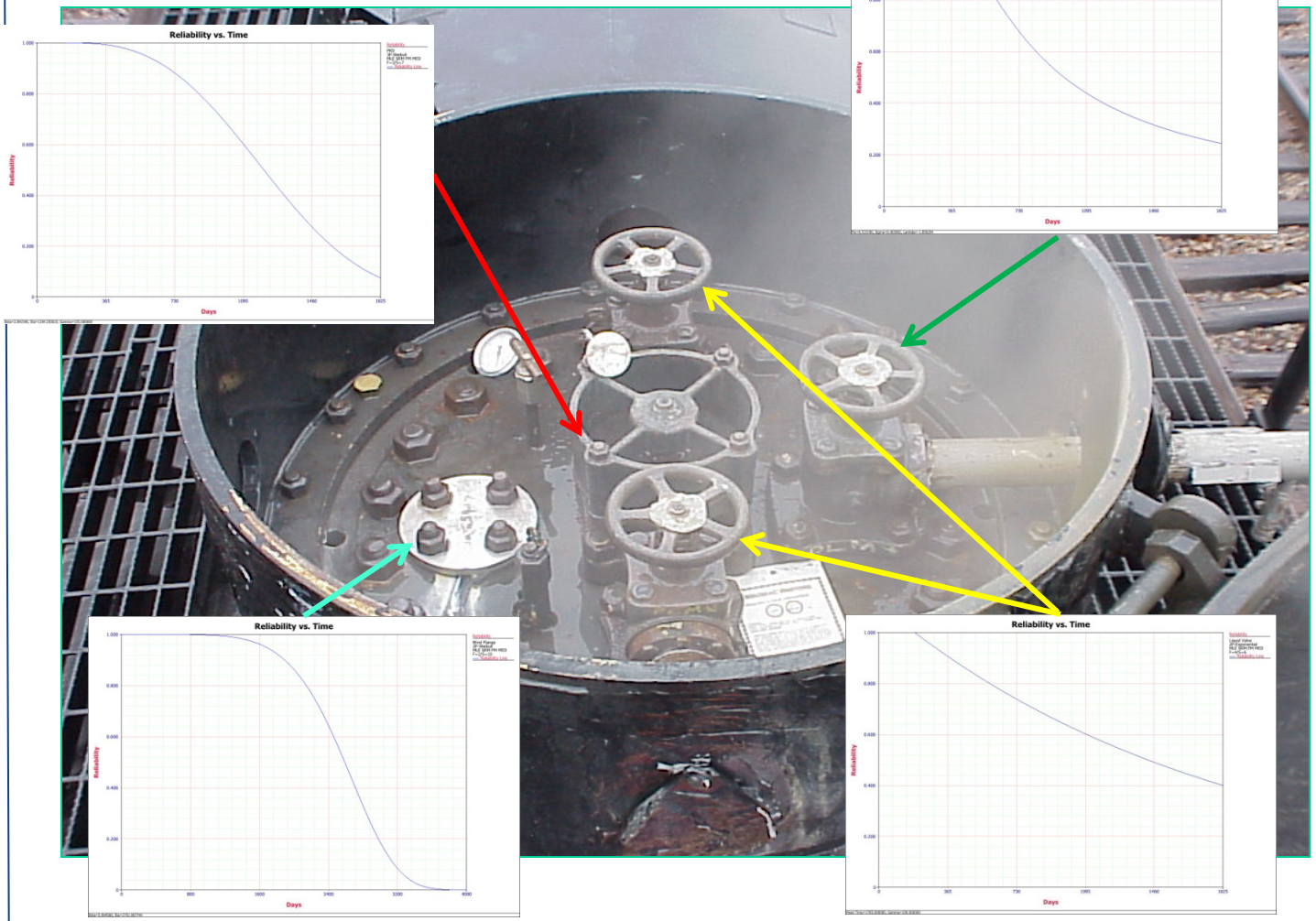
- Reliability of Complex Systems



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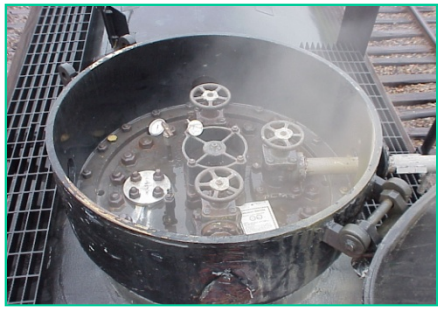

- Reliability of Complex Systems

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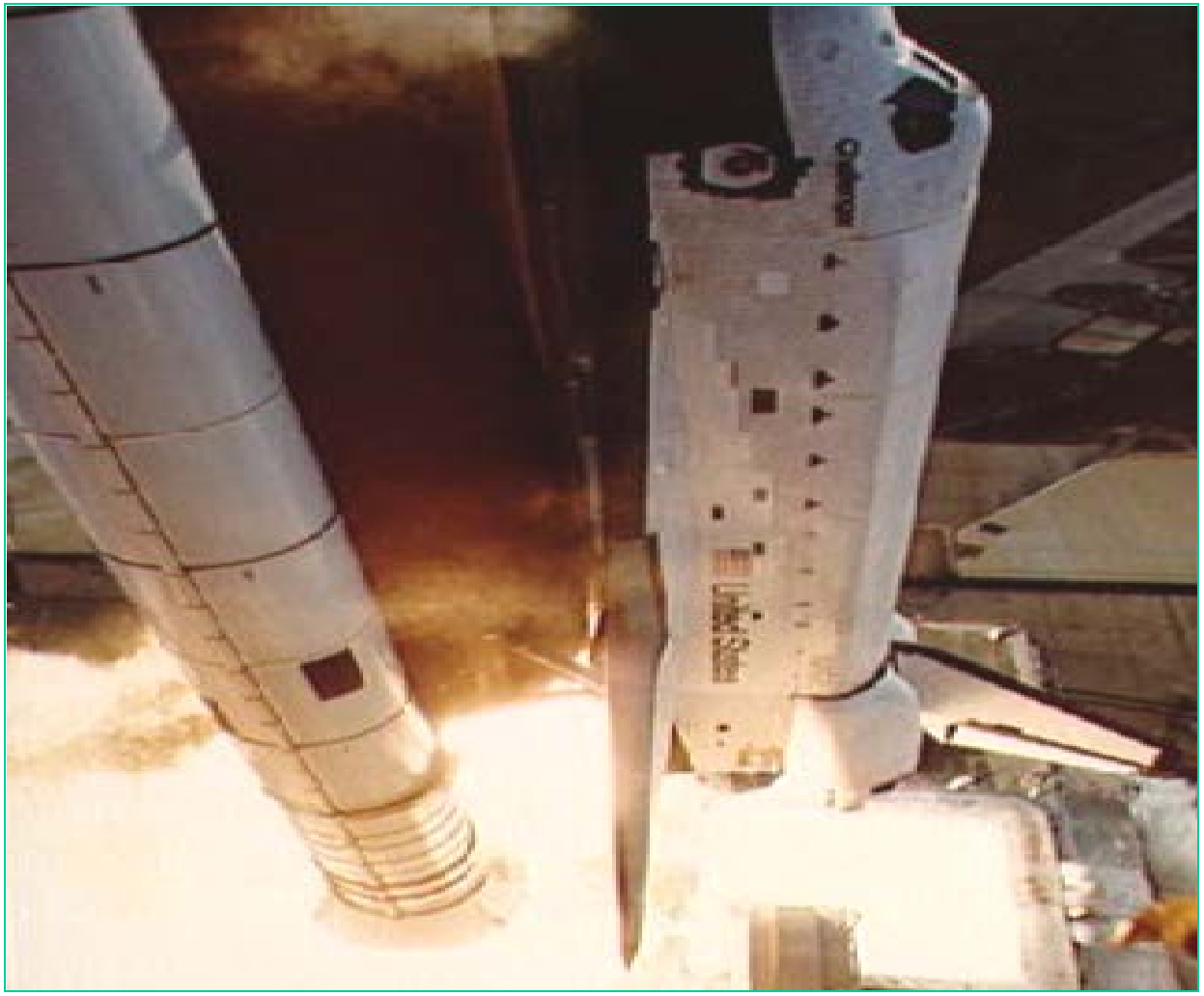
Notable Reliability Failure



NASA Challenger Explosion – 01/28/1986

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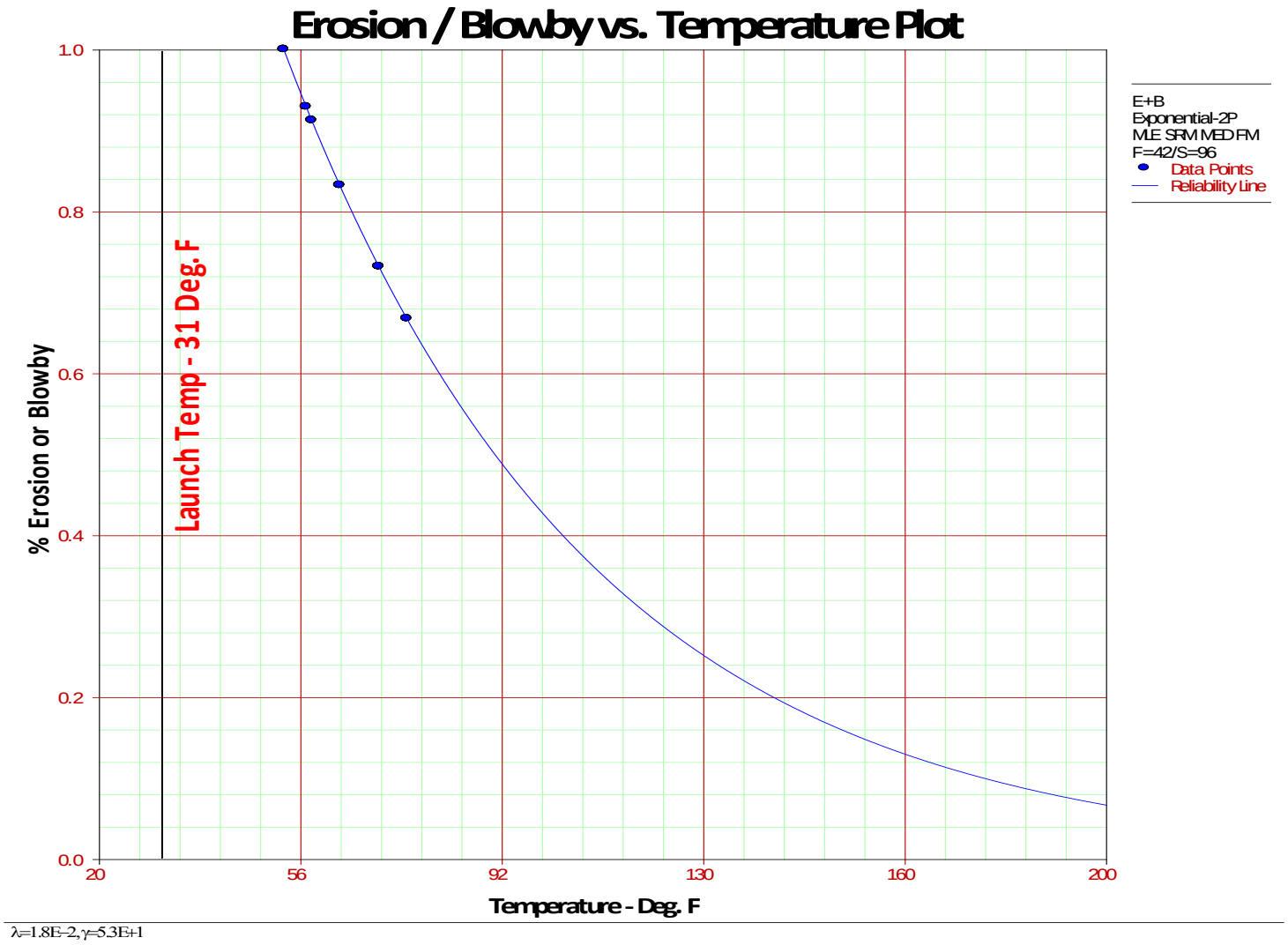
Notable Reliability Failure



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FRA Case Studies

- Tank shell crack

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FRA Case Studies

- BOV Saddle Gasket

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HM 216B *Where We're Going*

Tank Car Owners Shall:

- Develop written Qualification & Maintenance (Q&M) program
- Ensure facilities inspect, test, evaluate, mark, document results, send documents to car owner
- Collect and analyze inspection data, use to validate qualification intervals to maintain design level of safety and reliability.
- Measure the execution and effectiveness of Q&M program.

Tank Car Facilities Shall:

- Follow car owner approved Q&M program
- Obtain car owner approval prior to repairing car
- Provide car owners with inspection & test records

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Summary & Questions

- FRA believes hazmat safety can be improved by properly specifying, designing, manufacturing, and maintaining tank cars.
- FRA regulations and new AAR specifications will improve tank car safety in accidents.
- FRA believes safety and reliability are achieved by developing and adhering to Qualification & Maintenance (Q&M) programs.
- Car owners must ensure shops are executing to their approved Q&M programs and procedures (work instructions).
- Car owners must ensure their Q&M programs and procedures are effective at preventing hazmat incidents and reducing risk.
- FRA encourages robust nonconformance reporting, data collection, and analysis systems to achieve safety and reliability.

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Summary & Questions

"Our business will look more like the airplane business and less like the boxcar business" Unknown