



# WELCOME!

Topic Lecturer:

Christopher J. Gamblin

Director, Technical Services

ASNT LEVEL III No. 176360



# Discussion Scope

LT Method and BLT Technique  
application for those employees  
that are not needing certification to  
a code and standard.



# CFR 173.31 (d)

- (d) Examination before shipping. (1) No person may offer for transportation a tank car containing a hazardous material or a residue of a hazardous material unless that person determines that the tank car is in proper condition and safe for transportation. As a minimum, each person offering a tank car for transportation must perform an external visual inspection that includes: ...



# Leak Testing Methods

- Divided into three main categories by American Society of Non-Destructive Testing.
  - Leak Detection,
  - Leak Location,
  - Leak Measurement
- Bubble Leak Testing is an example of both Leak Detection, and Leak Location.



# Three Techniques of LT

- Three common LT techniques for tank car inspection:
  - Bubble leak testing – liquid film (BLT)
  - Chemical Reactivity (CRLT)
  - Pressure change or Pressure Decay



# Leak Testing

- LT is a form of NDT that uses either a pressurized or evacuated system to detect the location of leak and possibly measure the leakage through the leak.
- LT when compared to other methods, either surface (MT, PT) or Volumetric (UT, RT), has a higher degree of sensitivity to locate the leak or measure leakage.



# Leak Testing Definitions

## ■ Leak;

- Physical hole that exists and not the quantity of fluid passing through.

## ■ Leakage:

- The flow of fluid through a leak without regard to physical size of the hole through which flow occurs.

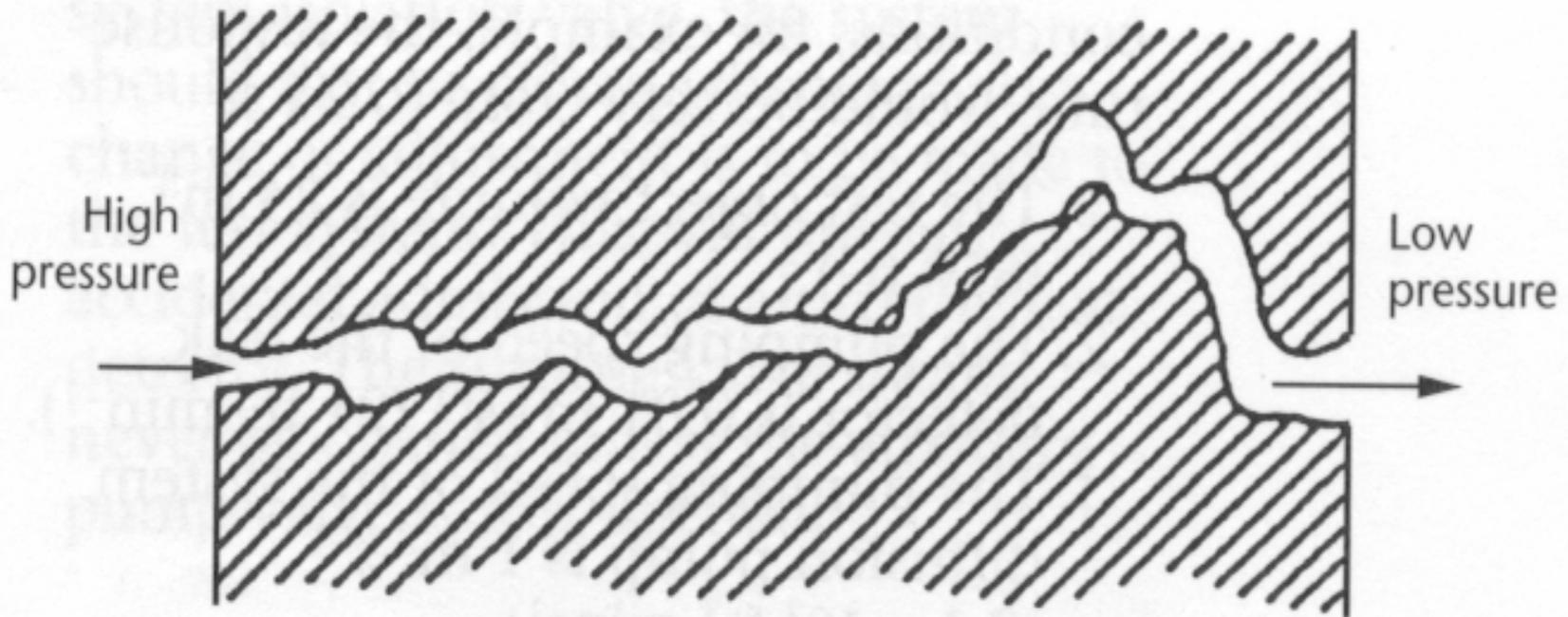


# Leak Tight

- Term *leak tight* is relative. Nothing is truly *leak tight* and different terms should be used.
- Terms *no detectable leakage*, *no leakage*, or *zero leakage* truly represent the desired condition before shipping a tank car.
- Everything leaks, absolute tightness is only theoretical in practice. Nothing made by humans can truly be absolute leak tight.



# Leak Path



# Leak Rates/Sensitivity

- LT techniques are measured in leak rates. The smaller the leak rate detected, the higher the sensitivity.
- Examples of minimum detectable leak rates:

Ultrasonic Leak Detector	<b><math>10^{-1}</math> std cm<sup>3</sup> per second</b>
Bubble Leak	<b><math>10^{-3}</math> std cm<sup>3</sup> per second</b>
Mass Spectrometer detector probe	<b><math>10^{-5}</math> std cm<sup>3</sup> per second</b>
Radioactive Isotope	<b><math>10^{-8}</math> std cm<sup>3</sup> per second</b>



# 1 std cm<sup>3</sup> per second

- Quantity (mass) of a gas leaking in one second.
  - Volume equal to three dimes stacked vertically.

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<b>10<sup>-2</sup></b>	10 seconds
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<b>10<sup>-3</sup></b>	100 seconds
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<b>10<sup>-5</sup></b>	3 hours
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<b>10<sup>-8</sup></b>	1 year
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<b>10<sup>-12</sup></b>	3000 years
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# Reasons for Leak Testing

- (Economic) To prevent material loss that interferes with system operation.
- (Safety) Prevent fire, explosion, and environmental contamination.
- (Reliability) Detect unreliable components, and those with leakage rates that exceed standards.



# System Reliability

- LT is an important process to the measure the reliability of the system under test.
- LT can show a fundamental fault of the system. High leakage rates in specific areas may determine:
  - Gasket improperly aligned
  - Valve connections misaligned or improperly threaded



# System Reliability

- LT is not a direct measurement of continuing system reliability, only a measurement of the reliability at the time of testing.
- Primary use of LT for railroad tank car industry is to detect installation errors.



# LT Operator Training

- LT sensitivity depends heavily on the skill level and alertness of the LT operator.
- LT operators must be trained in the fundamentals of LT to ensure they are performing a LT correctly each time.
- Common errors:
  - Operators do not look at test joint for an acceptable period of time
  - not identify all possible leak paths



# LT Operator Training

- Training plans for LT operator personnel should include:
  - Disadvantages and advantages of LT methods
  - Identify hazards with LT
  - Enhancing testing environments
  - Techniques for improving inspection skills
  - Factors affecting LT measurement accuracy
  - Proper ways to carry out and conduct LT methods



# Bubble Leak Testing

- Leak Testing technique must be of proper sensitivity for scope of test, and also be economical value for the technique to be desirable for application.
- Bubble Leak testing accomplishes both of these criteria, and represents most of the LT performed in the RR Tank Car Tank industry.



# Bubble Leak Testing

- Three techniques classified by the how the liquid used for detection is applied:
  - Liquid Immersion
  - Liquid Film
  - Foam application



# BLT Advantages

- Simple to use, rapid application, and inexpensive
- Sensitivity is acceptable for use with tank car tanks
- Enables the observer to locate the exit point of leaks very accurately (compared to Pressure Change Test)
- Very large leaks and small leaks can be detected, offers a wide range of detection unlike some other techniques.



# BLT Advantages

- BLT allows observer to distinguish real leaks from “virtual” leaks.
- “Virtual” Leaks are those in which trapped gases are escaped during a test and are observed.
- Safe to apply BLT with proper inert gases, and testing liquids, in combustible areas.



# BLT Limitations

- When performing BLT, or any LT technique beyond its limitations, it renders the test inaccurate and the results **dangerously** false.



# BLT Limitations

- Certain conditions interfere with BLT, and must be corrected prior to testing.
  - Contamination of test specimen
  - Improper test temperatures
  - Contaminated Leak Test solutions
  - Prior contaminates that clog leaks or leak paths
  - Air dissolved in test liquids, or out gassing from connections. “Virtual Leaks”



# BLT Limitations – Surface Cleaning

- Importance of cleaning test surface
- Cleaning a tank car connection prior to performing a LT should include as a guideline:
  - Remove by safe means any signs of rust, grease, oxide films, or other visible surface contaminants.



# Commercial vs “Homemade” BLT Solutions

- Non-technical applications of LT can cause ordinary soap and water combination to be used.
- While economical, these testing solutions diminish the sensitivity of the test, possibly causing them to be lower than  $10^1$  std cm<sup>3</sup> per second.
- Example: Dishwashing soap and water



# Commercial vs “Homemade” BLT Solutions

- Limitations of Common Soap for BLT
  - Soaps form sticky, gummy deposits that can clog leaks. “Bath tub ring”
  - Soaps are alkaline; pH values of 10.5 to 11.5. Can cause severe corrosion to Aluminum Alloys.
  - Soaps contain chlorides and borates. These can cause stress corrosion cracking on stainless steels or titanium alloys. Many valves are SS or  $_{22}\text{Ti}$ .



# Commercial vs “Homemade” BLT Solutions

- Commercial BLT solutions are favorable over “soap and water” when compared:
  - Have pH between 6-8
  - Do not form deposits when mixed with “hard water”
  - Viscosity allows low surface tension, allows BLT solution to spread over surface
  - Stabilized solutions are resistant to bacteria and maintain sensitivity over long periods of time
  - Allow BLT solution to dry to a clean state
  - Temperature range  $-30^{\circ}\text{F}$  to over  $150^{\circ}\text{F}$

Source: ASNT NDT Handbook, 3rd Edition. Volume 1; Leak Testing



# Commercial vs “Homemade” BLT Solutions



# Commercial vs “Homemade” BLT Solutions



# Commercial vs “Homemade” BLT Solutions



# Process Steps for BLT

- First and foremost, safety is key in working with loaded tank cars or any pressurized vessel.
- Along with tank car shipping location safety standards, LT safety briefings should include these topics:
  - Working with pressurized vessels
  - Hazards with going on top of, or below tank car.



# Process Steps for BLT

- Clean areas of interest to BLT. Remove dirt, slag, rust, or any foreign debris.
- Consideration of the cleaning chemical must be taken in consideration for compatibility with BLT solution.



# Process Steps for BLT

- Create pressure differential. Creating a high pressure side, and lower pressure side will start leakage to flow.
- General guidelines state that a minimum of 15 psig (210 kpa) be used as a starting pressure.



# Process Steps for BLT

- Temperature should be checked prior to applying the BLT solution.
- Use IR or contact thermometers. Must be between temp limits of BLT solution.



# Process Steps for BLT

- Apply BLT solution.
  - Flow solution over test area, not creating bubbles in the process
  - Do not brush or spray unless LT solution is designed for such application!
  - Gently flowing solution over area will allow complete coverage. Care should be taken to observe the solution as it is applied.



# Process Steps for BLT

- Allow BLT solution to Dwell on the test area for a specific amount of time.
  - Usual Dwell times are 5min -10min
- After Dwell time has elapsed, inspect area for bubble formation



# Process Steps for BLT

- Inspection should be done in a adequate environment to get the best results for the test.
- Improve the environment to increase the sensitivity of the test:
  - Increase lighting
  - Better position to keep view angle at 0°-15°
  - If possible, improve temperature, wind, humidity
  - Use BLT solutions that have higher visibility



# Inspection

- Test joint must show no bubble formation to be considered to pass the leak test
- BLT will show bubbles collapsing and reforming to indicate a leak



# LT Procedure

- LT procedure should be written by an ASNT Level III
- Allows for uniform application by all LT operators
- Specifies the minimum requirements for conducting a test
- A procedure should list all aspects of the LT that are essential to be met
- Can provide reasonable certainty that a specific sensitivity is being met



# LT Procedures

- Procedures should include:
  - Cleaning requirements
  - LT solution
  - Temperature limits
  - Test Pressure
  - Acceptable leak rates (Acceptance Criteria)
  - Reporting of a leak
  - Cleaning practice



# THANK YOU!

## CONTACT INFO

Christopher Gamblin:

Watco Compliance Services, LLC

**EMAIL: [cgamblin@watocompanies.com](mailto:cgamblin@watocompanies.com)**

**PHONE: 713-703-5123**

