Post Installation Testing: A New Standard of Tightness

UST/LUST Conference 2005

Key Topics

- Results of Sensitive leak detection on newly constructed systems
- Survey of problem areas: detecting, finding and fixing leaks
- Comparison of the fundamental limits of various test methods: pressure, vacuum, acoustic and tracers

Post-Installation Tests by Month: ~ 1/day

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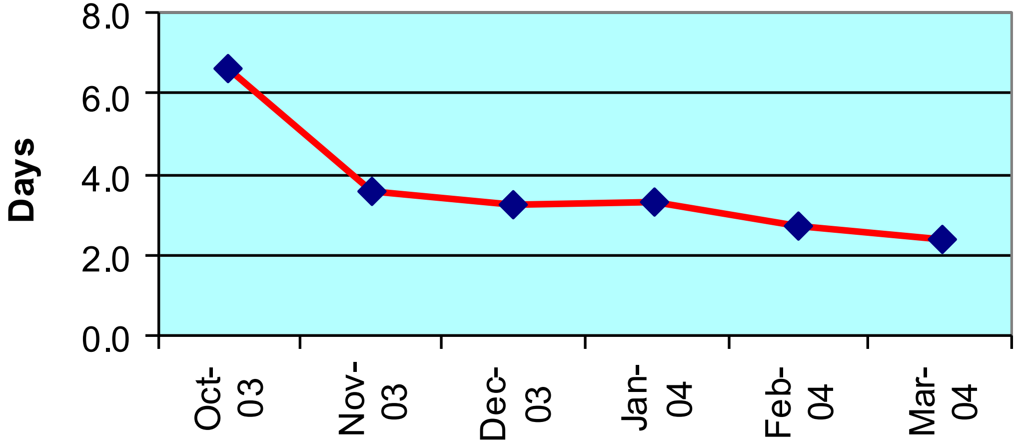
Month	Facilities Passing by Month (selected months)	Total Passing Facilities
October 03	4	4
Feb	27	110
July 04	44	284
November 04	14	385
January 05	22	424

Average Number of Days for ELD Test by Month

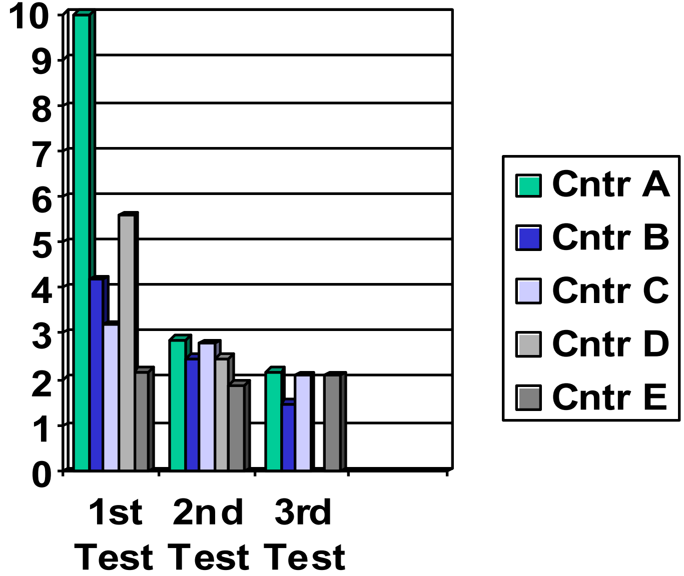
(Systems are getting tighter)



	Oct-03	Nov-03	Dec-03	Jan-04	Feb-04	Mar-04
Avg Days for Pretest	6.6	3.6	3.3	3.3	2.7	2.4
Number of Facilities	4	17	25	37	27	14

Experience Gained by Contractors

- Contractors A, B, C and D lowered final test costs by assembling facilities with fewer leaks
- Contractor E started well and displays consistent quality
- Good assembly and pre-cover testing saves time and money



What has been learned

- With the right tools, it is straight forward to assemble a system that is tight to the limits of the component materials.
- When installed to manufacturer's specifications, UST components are usually tight.
- Many contractors are good at building systems that are tight to the Enhanced Tracer Tight standard.
- Experience with the test improves installation practices.

What are the common problems?

- In order of descending frequency of occurrence
  - Automatic Tank Gauge access riser caps and signal cable penetrations
  - Spill bucket drain valves
  - Improper joints, improperly seated rings and gaskets, moving joints while curing
  - Threaded fittings, FRP to steel, scarred threads from bad dyes
  - Bruised or crimped piping
  - Flex connectors
  - Shear Valves
  - Spill Bucket connections and significant leaks from drain valves
  - Access to the flex pipe chase outside of double wall UDCs

Estimates of Frequencies at New Facilities

- During testing prior to backfilling
  - Facilities requiring:
    - Repair to primary product piping: ~10%
    - Repair to vapor or vent piping: ~10%
- During testing after covering and paving
  - Facilities requiring:
    - Repair of buried piping that was not pre-tested: ~20%
    - Some repairs to tank top fittings ~80%
    - Pre-tested facilities that require more than 1 to 5 minor repairs during final testing: <3%

Introduction to Photos to Follow:

- All of the following leaks were discovered after the assembled system had passed inspection.
- These leaks were detected or located using tracers. In some cases it was difficult to get the soap signal for the photograph. In some cases it was not possible to create and/or view the soap signal.

Leak at ATG cap cable penetration

A common leak location at the spill bucket mounting ring

Leak at threaded riser-adapter connection

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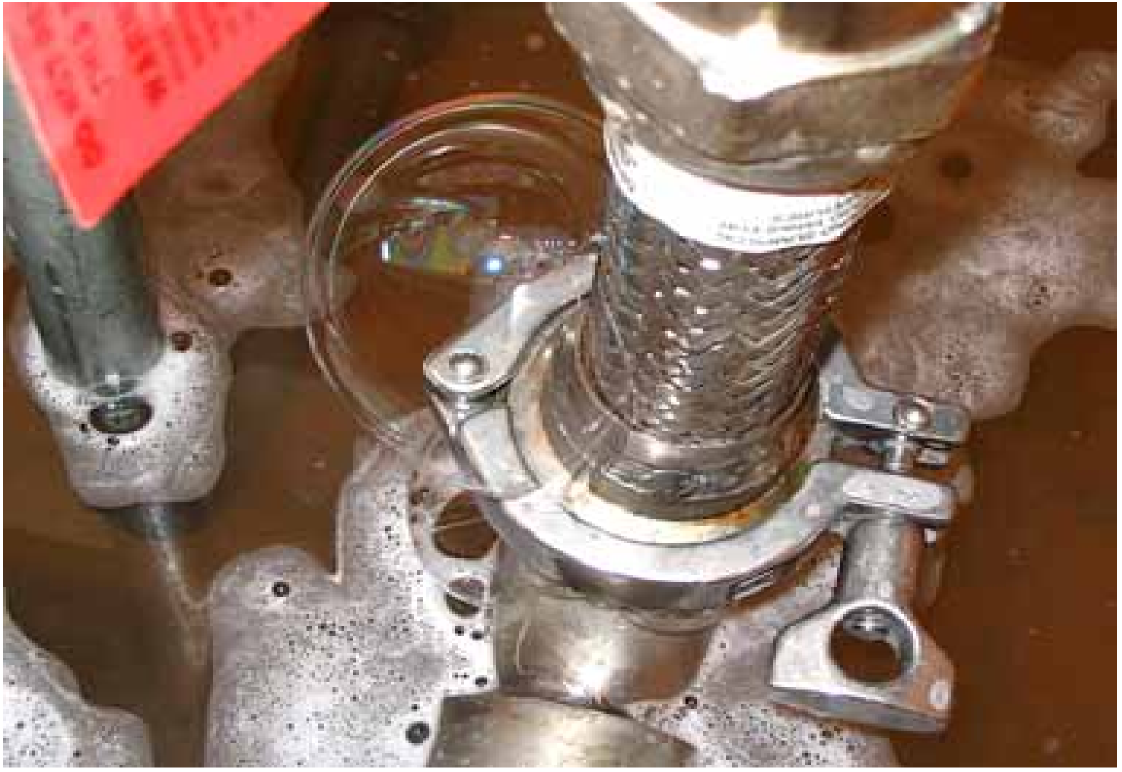
Fairly common leak at actuation arm for shear valve

Easy-to-detect leak around crimped o-ring



Small leak, damaged pipe, camera below pipe

Star crack, impact damage

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No visible problem, multiple leaks across outlined section, no soap signal

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Leak at the same joint in both elbows

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Abuse of cleaned secondary piping, possible future adhesion failure

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Stress crack formed when rain collapsed cardboard-box pipe support

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Areas of Focus

- Single walled systems need to be proven tight to a higher standard.
- Tank top leaks need to be addressed.
- Petroleum liquids and vapors need to be segregated from water and soil.
  - Keep the leaks in the sumps.
  - Keep the sumps and spill buckets clean.
  - Isolate the sumps and spill buckets from the soil.

Post-installation Leak Detection Standards

- At what magnitude is a leak too big to ignore?
  - 10 pounds per year
  - 100 pounds per year
  - 1,000 pounds per year
- 13 pounds per year (2 gallons liquid, 2000 gallons vapor):
  - 0.0002 gallons per hour of liquid
  - 0.2 gallons per hour of vapor
- It is likely that the mass of gasoline released sets the level of the contamination.

How Tight Should Systems Be?

- 0.1 gph (liquid test fluid)
  - Each system can release 6,000 pounds (3 tons) of gasoline each year.
- 0.005 gph (liquid test fluid)
  - Each system can release, 44 gallons or 300 pounds each year.
- 0.0005 gph (liquid test fluid)
  - Each system can release 4.4 gallons or 30 pounds each year.
- Currently, using air as a test fluid in product lines during post-installation testing at a sensitivity of 0.005 gph, the largest possible liquid leak from system in service - 0.0002 gph:
  - Each system can release, 2.5 gallons or ~15 pounds each year.

Third Party Evaluations

- As the UST testing market matured, the Tracer Tight methods were designed to be less sensitive and leak rates evaluated by third parties were raised.
- Midwest Research Institute, 1987
  - 0.0005 gph, (not EPA protocol)
- Ken Wilcox Associates, 1990
  - 0.05 gph, P(D) 0.97, P(FA) 0.03
  - 0.005 gph, P(D) 0.97, P(FA) 0.03
- Control Strategies Engineering, 1992
  - 0.05 to 0.1 gph P(D) >.99, P(FA)<0.01
  - relationship between tracer sensitivity was reported quantitatively, data can be used to support system certification at lower leak rates

Summary

- Leak detection with enhanced sensitivity has been shown to identify leaks from UST systems that pass other inspection standards.
- Contractors are constructing sites to a higher level of quality, leading to increases the numbers of tight sites at the time of commissioning.
- Current leak detection standards are not good enough. 900 gallons or 3 tons of gasoline per year is too much to ignore.
- Systems are as tight as the test. You get what you measure.
- The best time to detect a leak is before the system gets covered and then before it goes into service.

Comparison of Test Methods: Limiting Factors

- Pressure Testing (includes partial vacuum testing):
  - Barometric pressure changes: +/- 0.5 psig
  - Temperature changes: 0.03 psig/F (+/- 0.6 psig for 20 F change)
- Vacuum Testing
  - Out-gassing from the container material: 0.05 to 0.5 gph for FRP piping
- Acoustic Testing
  - Test fluid, hole geometry, material, distance, background noise, test pressure. Not predictive of tracer test outcome.
- Tracer Testing
  - Maximum tracer concentration: 10^{12} parts per trillion
  - Dilution volume: 1,000 gallons
  - Minimum detection limit: 10 parts per trillion
  - Limit of leak rate sensitivity: 10^{-8} gallons per hour

Table 2. Out-gassing rates of steel and fiberglass containers: Apparent leak rates for piping and an equal volume sphere

Material	Helium permeation break-through (hours)	Evacuation period (hours)	Out-gassing rate (torr·liters per cm^2 per second) X 10^9	Apparent leak rate for 150 feet of 2-inch piping (gph)	Apparent leak rate for equal volume sphere (gph)
New steel	N/A	1	700	0.06	0.008
New steel	N/A	24	90	0.008	0.001
New steel	N/A	27 vacuum 15 ambient 1 vacuum	200	0.02	0.003
Rusted steel	N/A	27	90	0.008	0.001
Fiberglass thick wall	> 27	1	1,700	0.16	0.02
Fiberglass thin wall	< 1	1	1,300	0.13	0.016
Fiberglass thin wall	< 1	2	900	0.08	0.01

Time Required to Detect a Leak

- 0.005 gph leak of air from a 150 ft x 2" pipe

  - Pressure testing: 7 to 14 days
  - Vacuum testing: 3 to 5 days
  - Acoustic testing: Not achievable
  - Tracer testing: 3 minutes

Sensitivity Comparison

- Typical Construction Inspection:
  - 2-8 gph of air
  - 0.1-0.4 gph of gasoline (6000 to 20,000 pounds per year)
- Vacuum testing
  - 0.04 to 0.1 gph of gasoline
- Acoustic Testing
  - No apparent impact on ELD results
- Tracer leak detection
  - 0.05, 0.005 and 0.0005 gph, third party certified
  - Available at any desired level of sensitivity
    - Higher sensitivity does not directly influence the cost