API 653 TANK INSPECTION, TANK MAINTENANCE, AND CAUSES OF TANK FAILURE

HEARTLAND
TANK SERVICES, INC.


07/23/2(


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API 653 Tank Inspections

Why Inspect Your Tanks?

- Prevent leaks into your secondary containment or to groundwater (if you do not have a secondary containment system)
- Establish a baseline of tank condition and corrosion rates
- Identify problems to perform repairs before you have a significant leak or release - **Maintain your capital asset**
- Minimize chance of catastrophic tank failure

PROPER INSPECTION PROTOCOL

INSPECTOR CREDENTIALS

- Certified API 653 Inspector
  - Four years minimum experience with storage tanks
  - Must pass test conducted by American Petroleum Institute (API)
    - Inspectors receive an individual inspector number
    - Inspector testing required every three years

PROPER INSPECTION PROTOCOL

- Visual inspection of welds, plates, and appurtenances
- UT (Ultra-sonic Thickness) testing of shell courses, floor, and roof
- Vacuum testing of all floor weld seams – unless epoxy coated
- Identify bottom side corrosion on floors
- Settlement Survey
  - Checking for planar tilt
  - Check for floor bulges or depressions
- Provide calculations for safe or maximum fill height

Weld deterioration

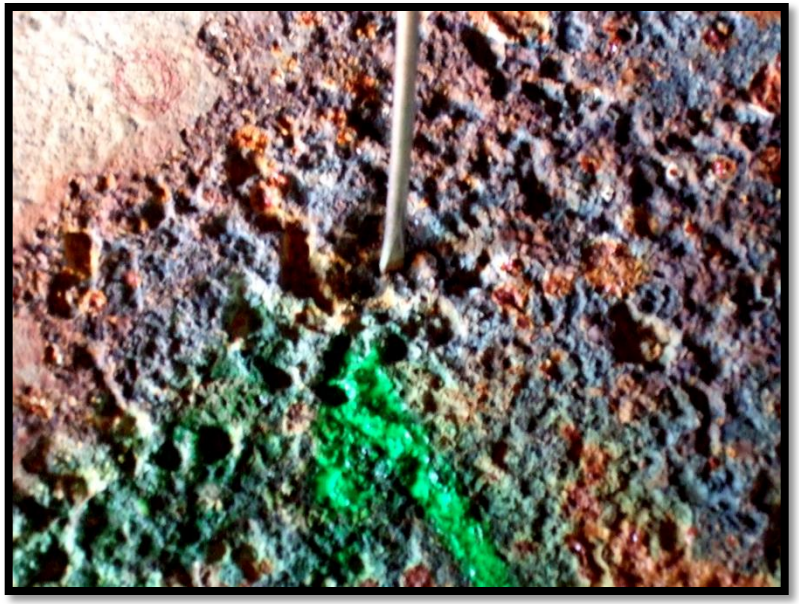


Plate corrosion

Interior piping corrosion

Shell corrosion

Weld deterioration and four-way junction – NON API

Four-corner insert with reinforcing backup – NON API

Evidence of interior shell corrosion

Foundation evaluation

Floor plate corrosion

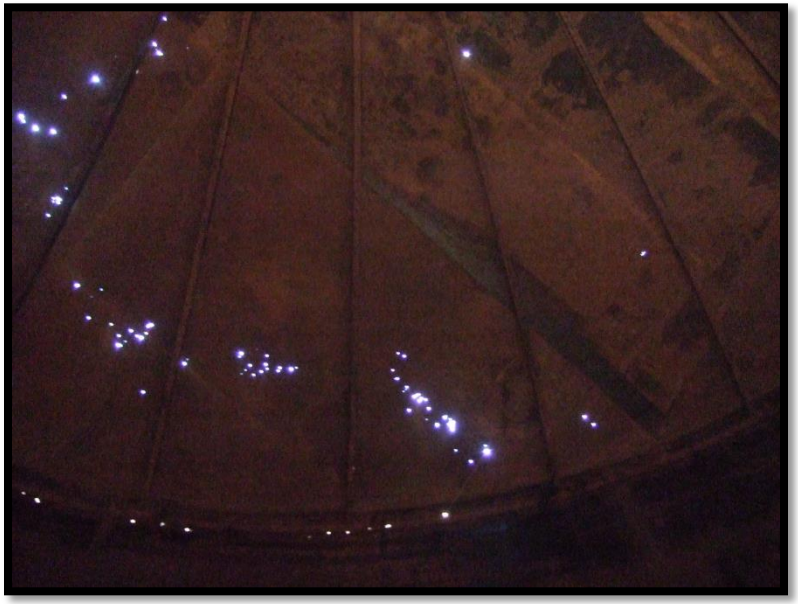
Lap-welded seam leak

Floor coupon with bottom side corrosion

Floor top side corrosion

Severe roof corrosion

Star light . . . Star bright!



SHELL SETTELMENT SURVEY

API-653 APPENDIX B SETTLEMENT EVALUATION

Date: 6/9/2010

File No	Report No	Client	Inspector	Tank No	1st Crs Plt Spec
7	HTS-10-221		Doug Perry	#1	Unknown

$$S <= 11L^2Y/2EH$$

U = Measured out-of-plane settlement in relation to a cosine curve, in feet
S = Deflection, in feet, (out-of-plane distortion)
L = Arc length between measurement points, in feet
Y = Yield strength, in pounds per square inch (psi)
E - Young's modulus, in pounds per square inch (psi)
H = Tank height, in feet

D	L	Y	E	H	S - Max Permissible
52	20.42	30000	29000000	31.5	0.075

	Feet	Inches	Feet	U	S	Results
Point 1	3	9.000	3.75	0.000	0.002	SAT
Point 2	3	9.200	3.77	0.007	0.000	SAT
Point 3	3	9.400	3.78	0.014	-0.001	SAT
Point 4	3	9.600	3.80	0.022	0.016	SAT
Point 5	3	9.400	3.78	-0.002	-0.009	SAT
Point 6	3	9.400	3.78	-0.008	0.008	SAT
Point 7	3	9.200	3.77	-0.030	-0.010	SAT
Point 8	3	9.200	3.77	-0.032	0.008	SAT
Point 9	3	9.000	3.75	-0.050	-0.010	SAT
Point 10	3	9.000	3.75	-0.049	-0.024	SAT
Point 11	3	9.000	3.75	-0.046	-0.009	SAT
Point 12	3	9.200	3.77	-0.025	0.008	SAT
Point 13	3	9.200	3.77	-0.019	-0.010	SAT
Point 14	3	9.400	3.78	0.006	0.017	SAT
Point 15	3	9.200	3.77	-0.002	0.000	SAT
Point 16	3	9.000	3.75	-0.010	-0.009	SAT

High Point: 3.75 Ft

Low Point: 3.80 Ft

Planar Tilt: 0.05 Ft / 0.60 In.

Cosine Curve R^2: 0.24

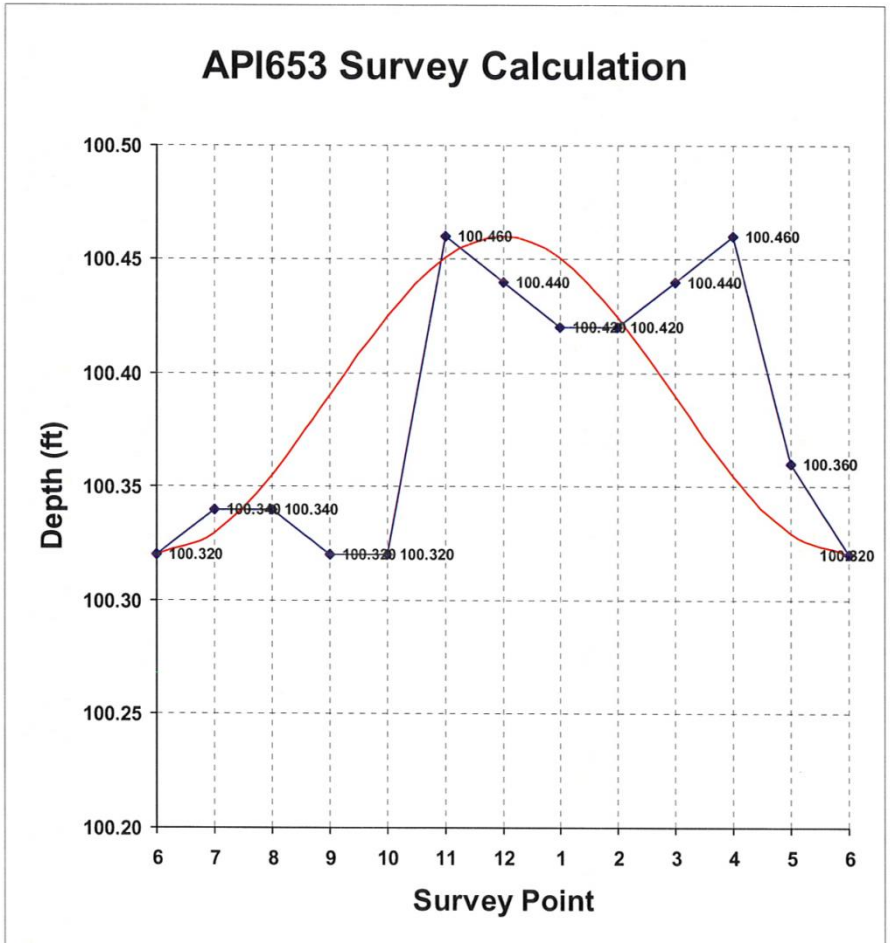
Notes:

Sixteen equally spaced settlement measurements were performed around the outside circumference of the tank at the floor plate that sticks out beyond the shell.

SHELL SETTELMENT SURVEY
API-653 APPENDIX B SETTLEMENT EVALUATION

Date 8/7/2010

Report No	Client	Inspector	Tank No	1st Crs Plt Spec
HTS-10-155		Richard Buntt	#17	A 36M



API-653 STORAGE TANK EVALUATION

AST Component Inspection Data

Report No	Client	Inspector	Vessel	Date
HTS-10			#2	

Component Thickness Measurements (in inches)

CML	Component	Location	tml-1	tml-2	tml-3	tml-4	tml-5	tml-6	Minimum
001	Shell Crs 1	Plt1	0.342	0.345	0.334	0.336	0.345	0.335	0.334
002	Shell Crs 1	Plt2	0.340	0.328	0.350	0.357	0.333	0.371	0.328
003	Shell Crs 1	Plt3	0.323	0.337	0.325	0.316	0.323	0.332	0.316
004	Shell Crs 1	Plt4	0.327	0.364	0.355	0.361	0.325	0.366	0.325
005	Shell Crs 1	Plt5	0.334	0.348	0.344	0.363	0.340	0.373	0.334
006	Shell Crs 1	Plt6	0.352	0.355	0.358	0.359	0.350	0.347	0.347
007	Shell Crs 2	Plt1	0.221	0.282	0.247	0.218	0.226	0.243	0.218
008	Shell Crs 2	Plt2	0.224	0.231	0.226	0.229	0.222	0.256	0.222
009	Shell Crs 2	Plt3	0.219	0.224	0.229	0.220	0.218	0.270	0.218
010	Shell Crs 2	Plt4	0.213	0.233	0.209	0.252	0.207	0.252	0.207
011	Shell Crs 2	Plt5	0.214	0.266	0.248	0.226	0.227	0.250	0.214
012	Shell Crs 2	Plt6	0.251	0.233	0.223	0.253	0.223	0.273	0.223
013	Shell Crs 3	Plt1 N.	0.212	0.204	0.195				0.195
014	Shell Crs 3	Plt2 S.	0.210	0.205	0.204				0.204
015	Shell Crs 3	Plt3 E.	0.189	0.185	0.183				0.183
016	Shell Crs 3	Plt4 W.	0.211	0.204	0.207				0.204
017	Shell Crs 4	Plt1 N.	0.196	0.217	0.194				0.194
018	Shell Crs 3	Plt2 S.	0.203	0.200	0.212				0.200
019	Shell Crs 4	Plt3 E.	0.189	0.190	0.195				0.189
020	Shell Crs 4	Plt4 W.	0.189	0.183	0.187				0.183
021	Roof	Plt1	0.213						0.213
022	Roof	Plt2	0.185						0.185
023	Roof	Plt3	0.186						0.186


08/18/2010


08/11/2010

TANK INSPECTIONS ARE NOT ALWAYS A BAD THING

THIS IS A HAPPY TANK

TANK MAINTENANCE – COMMON SENSE APPROACH

- Conduct monthly/weekly walk-around of your tank(s)
  - Look for stains on steel where leak may be occurring
  - Check valve function and nozzle welds
  - Check associated piping
  - Check foundation for wash-out/deterioration
- Keep good records of product in and out

TANK MAINTENANCE – COMMON SENSE APPROACH

- Open up your tank a minimum of every two years and conduct your own visual inspection inside
  - Check for weld deterioration and corrosion
  - If tank is coated, visually check coating for blisters or cracks
- Keep a record of inspections and results
- If tank has an internal containment liner, check leak monitor weekly
- Conduct an API-653 inspection of your tank every five years as recommended by **TFI (The Fertilizer Institute)**

Salting out of liquid fertilizer in lined tank

WHAT IS THE API 650 SPECIFICATION

API - AMERICAN PETROLEUM INSTITUTE

Worldwide Standard for Above Ground Storage Tank Design and Construction

- Provides requirements for calculations of shell plate thickness, man-way and nozzle design
- Provides procedures for shell, roof and floor construction
- Specifies material requirements and minimum thickness requirements
- Specifies weld construction requirements, weld spacing, and x-ray requirements

CAUSES OF CATASTROPHIC TANK FAILURE

TANK FAILURES – COMMON CAUSES

- #1 Cause: Corrosion
  - Weld deterioration/corrosion – especially in lower horizontal and vertical seams
- #2 Cause – Lack of Weld Penetration
  - Lack of full weld penetrations (lack of weld fusion)
  - Improper weld seam spacing
  - Lack of radiograph (x-ray) of newly constructed tanks or on repaired tanks

TANK FAILURES – COMMON CAUSES

- # 3 Other Causes
  - Operational errors
    - Over-filling of tank – excessive pressure
  - Brittle fracture of steel
  - Poorly designed or inappropriately installed
  - Lack of proper certified inspection
  - Tank erectors who know little about API Specifications and procedures – these companies attract customers with a "cheap" price. Make certain your contractor can verify that your tank meets API Specifications. **DO YOUR OWN HOMEWORK**

Cut-down and re-welded tank

Improper weld spacing

Double wall 500,000 gallon tank, Illinois 2008

Original tank foundation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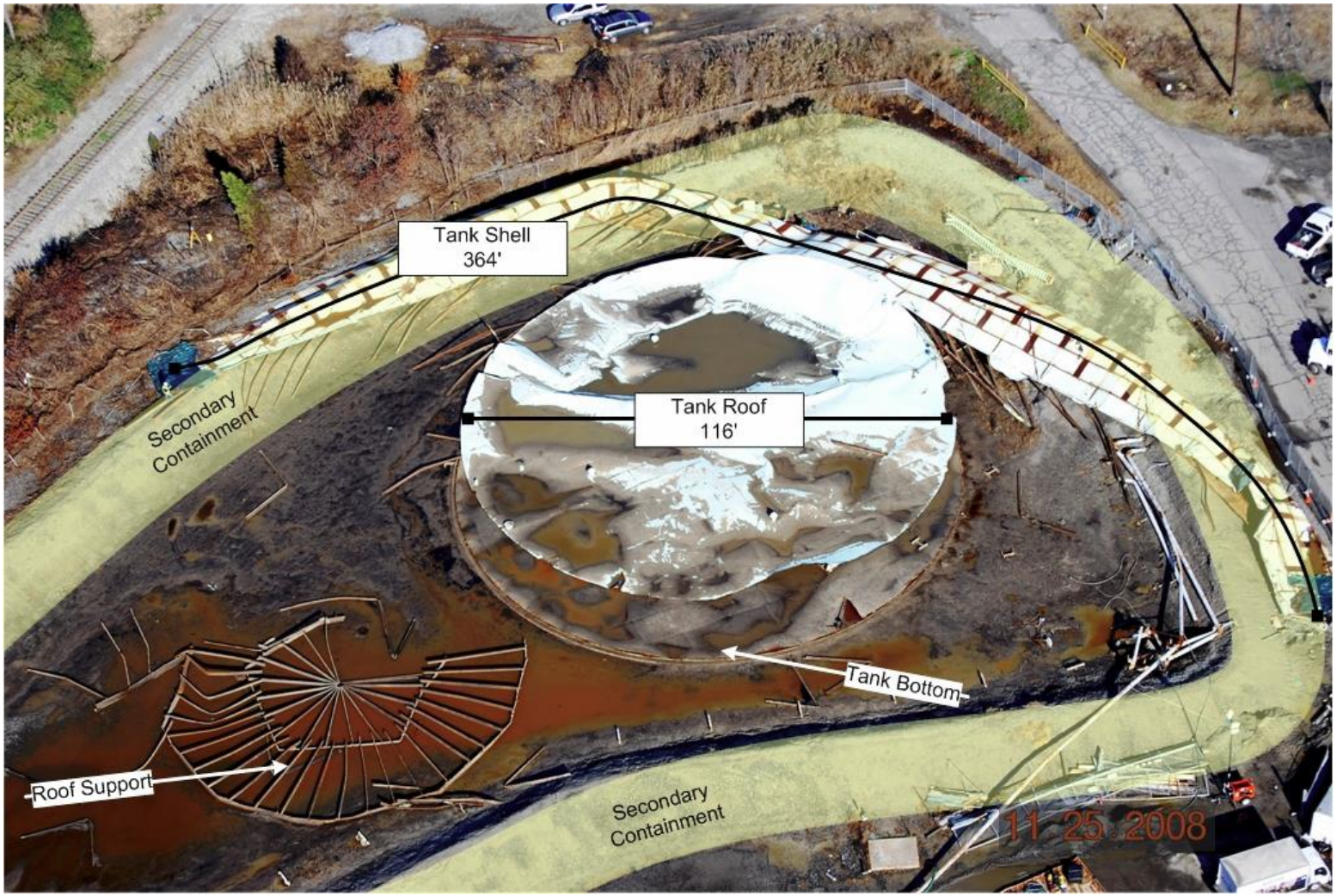
Tank Shell
364'
Tank Roof
116'
Secondary
Containment
Tank Bottom
Roof Support
Secondary
Containment
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Site Gauge after Earthquake.avi