Emergency Relief Venting for ASTs: Changes you probably missed!

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Emergency Relief Venting for ASTs

- NFPA, ICC and other codes and regulations include requirements for both normal and emergency relief venting for aboveground tanks.
- These requirements are also included in API 650 and UL 142 for new construction.

50 years ago…

- The worst event on record at the time:
- Kansas City explosion in 1959.
  - 21,000 gallon horizontal tank failed propelling the tank 94’ into the area where firefighters were on hoses killing five firefighters and one spectator.

Kansas City - 1959

Emergency Relief

- 1963 the National Fire Protection Association (NFPA) amended the fire code to require emergency relief vents in aboveground fuel storage tanks.
- Was the first retroactive modification made to the code. There was no “grandfather clause”.

Emergency Relief Venting for ASTs

- Normal Venting – The venting required because of operational requirements or atmospheric changes.
- Emergency Venting – The venting required when an abnormal condition, such as ruptured internal heating coils or an external fire, exists either inside or outside of a tank.
  - Definitions from API 2000, "Venting Atmospheric and Low Pressure Storage Tanks"

Emergency Relief Vents

- Openings in the tank – rim vents, oversized normal vents, etc.
- Special vent hardware designed to be closed under normal operations, but open when internal pressure exists.
- Long bolt manway covers.
- Frangible Roof – weak roof to shell joint.

Venting Capacity

- Vent capacity based upon a calculation of "wetted area" of a tank.
- Wetted Area
  - Vertical AST = the exposed shell area up to 30'
  - Horizontal AST = 75% of the total exposed area
  - Rectangular AST = the exposed sides excluding the top and bottom.
- Charts used to determine the vent capacity in cubic feet per hour (CFH)

UL 142: Emergency Venting is defined in a chart in addition to a calculated protocol.

8.4 A vent opening that provides for emergency venting shall have a capacity not less than that specified in Table 8.1. A vent opening that provides for both emergency and normal vents shall also have a capacity not less than specified in Table 8.1. Emergency vents are not prohibited from use for normal venting of the primary tanks if the tanks are marked as specified in 48.1.1(e).

Table 8.1
Emergency venting capacity for primary tanks and interstitial space of secondary containment tanks

Wetted surface, square feet[a,b]	Venting capacity, cubic feet per hour[c,d]	Minimum opening, nominal pipe size, inches[e]
20	21,100	2
30	31,600	2
40	42,100	3
50	52,700	3
60	63,200	3
70	73,700	4
80	84,200	4
90	94,800	4
100	105,000	4
400	312,000	8
500	354,000	8
600	392,000	8
700	428,000	8
800	462,000	8
900	493,000	8
1000	524,000	10
1200	557,000	10
1400	587,000	10
1600	614,000	10
1800	639,000	10
2000	662,000	10
2400	704,000	10

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Emergency Relief Vents

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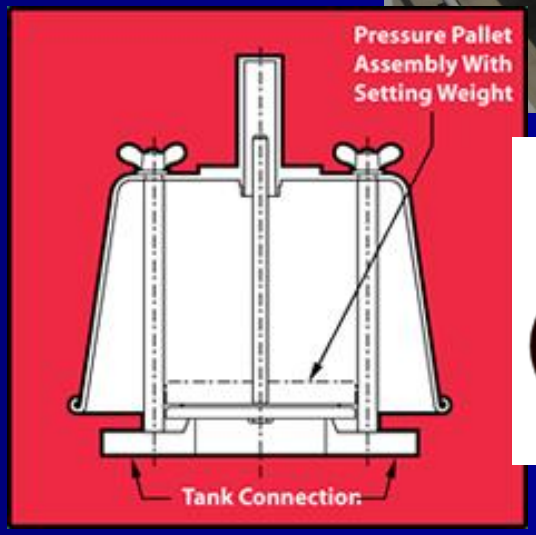
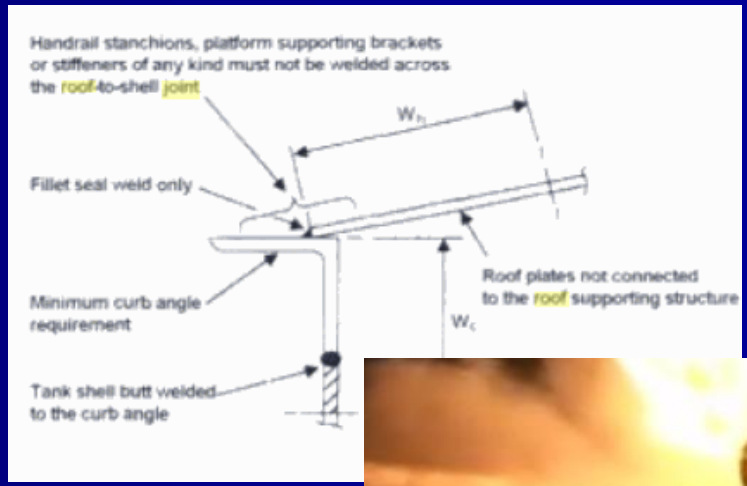


Emergency Relief Vents

- Long bolt manway covers.

Emergency Relief Vents

- Frangible Roof – weak roof to shell joint.



What's new?

- API began to study the frangible roof design in mid 1990's to develop calculations for design.
- Studies indicate that the standard design does not work effectively for tanks under 50' in diameter.

Texas Tank Fire

Study to Establish Relations for the Relative Strength of API 650 Cone Roof Roof-to-Shell and Shell-to-Bottom Joints

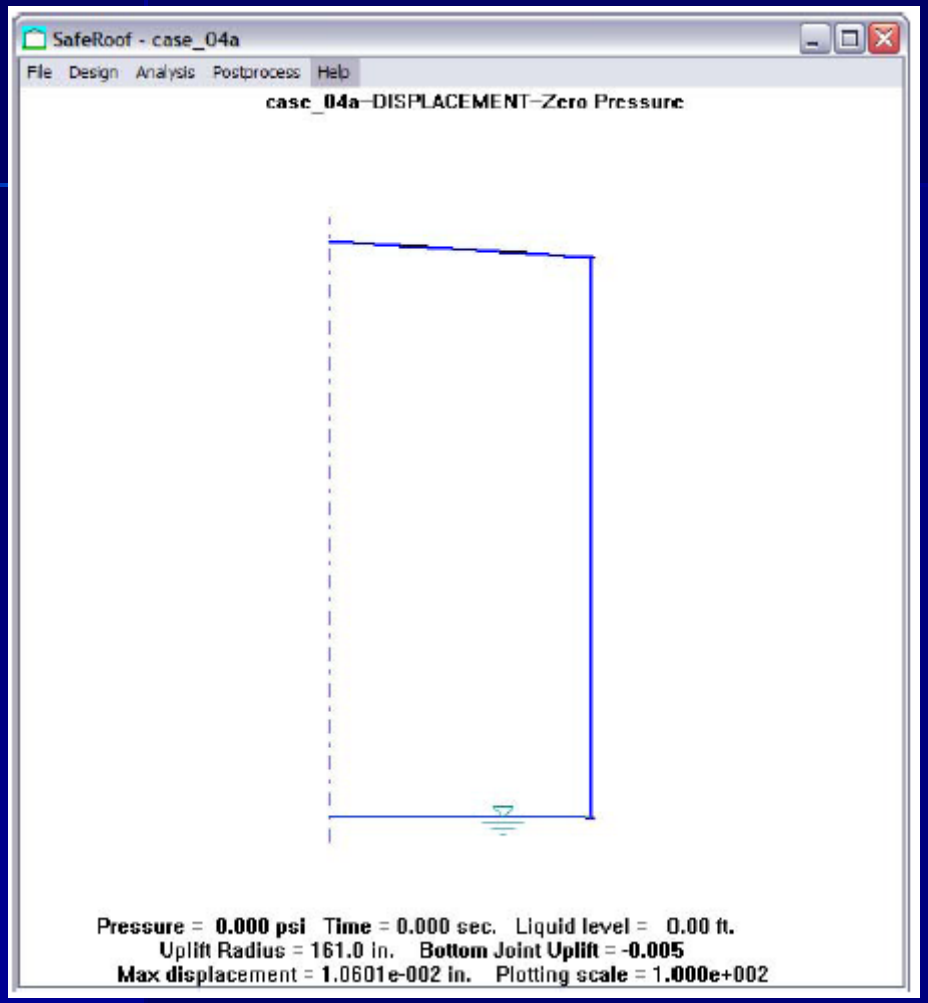
API PUBLICATION 937-A
AUGUST 2005

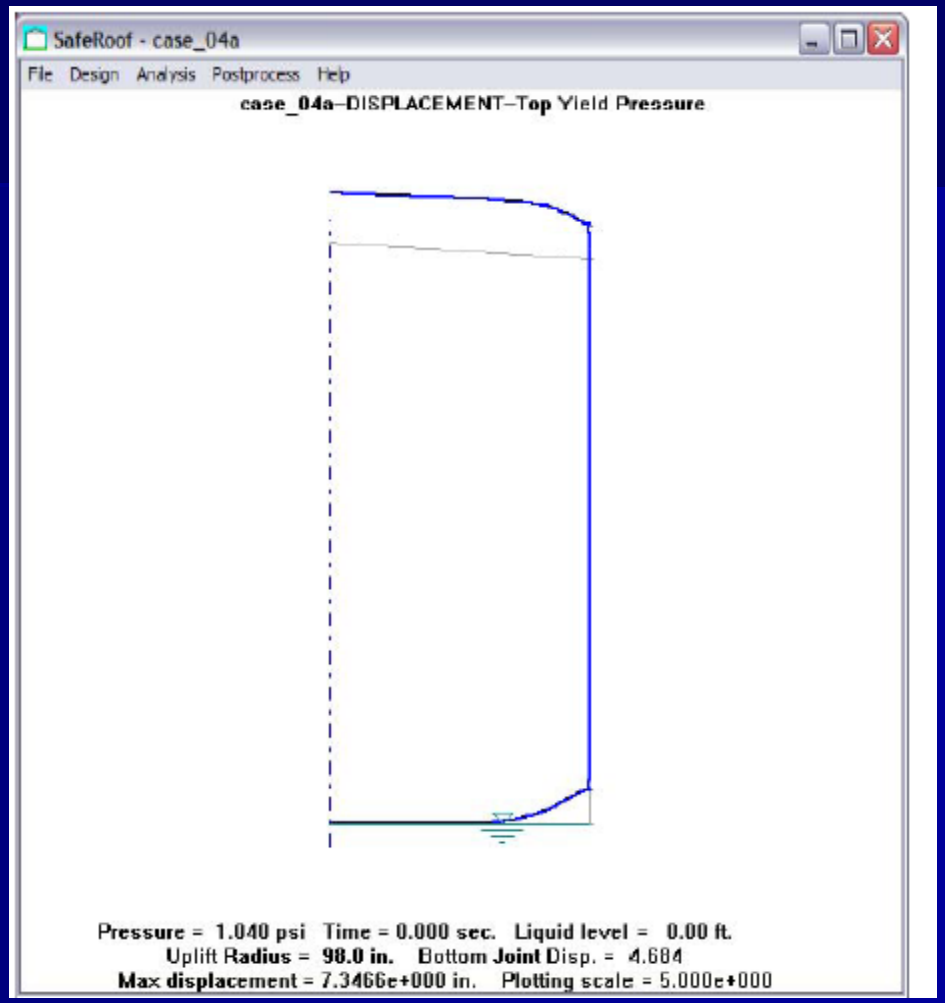
Critical Findings

- Frangible roof design for tanks under 50’ does not work without tank specific design.
- Evaluate the strength of the roof joint versus the shell to floor joint.
- Other means of providing emergency venting are recommended for small tanks.
- API 650 Paragraph 5.10.2.6 c) was revised to discourage the use of frangible roof design on small diameter tanks.

Additional information

- Even when the frangible joint is applicable, there are other design considerations that must be included in the overall tank design.


SafeRoof - case_04a
File Design Analysis Postprocess Help
case_04a–DISPLACEMENT–Zero Pressure
Pressure = 0.000 psi Time = 0.000 sec. Liquid level = 0.00 ft.
Uplift Radius = 161.0 in. Bottom Joint Uplift = -0.005
Max displacement = 1.0601e-002 in. Plotting scale = 1.000e+002


SafeRoof - case_04a
File Design Analysis Postprocess Help
case_04a–DISPLACEMENT–Top Yield Pressure
Pressure = 1.040 psi Time = 0.000 sec. Liquid level = 0.00 ft.
Uplift Radius = 98.0 in. Bottom Joint Disp. = 4.684
Max displacement = 7.3466e+000 in. Plotting scale = 5.000e+000

Additional findings

- For smaller tanks, significant uplift can be expected to occur at the top joint failure pressure. This means that the simple criterion of no uplift can not be used in the API 650 standard.
- For tanks expected to experience uplift, it is suggested that the design criteria be based on the relative strength of the bottom joint to the top joint.
- For tanks expected to experience uplift, it is necessary to ensure adequate strength in the bottoms of the tanks.
- If uplift is possible, tank appurtenances need to be designed or evaluated for movement of the tank.

Conclusions

- Emergency Relief Venting is a critical inspection point for evaluation of any aboveground fuel tank.
- Frangible roof designs are typically not adequate on tanks under 50’ diameter therefore alternate solutions are required.
- If NFPA thought it worthwhile to make the code change retroactive, so should API and STI in the evaluation of existing tanks.

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