TB 029-15

Lube Oil Storage Tanks-Fire Testing

Product: Roth DWT Lube Oil Storage Tank

Date: January 29, 2015 (Supersedes Tech Data Sheet)

Purpose-

This bulletin describes fire testing requirements and methods used to qualify nonmetallic tanks for the UL SU 2258 standard and additional general information regarding tank fire testing.

Section

1) Above ground storage tank product standards
2) Product standards that incorporate of fire testing into performance testing requirements.
3) Types of fire test methods in use
4) Comparison of test methods
5) Fire test protocols for metallic and non-metallic tanks

1) Above ground storage tank product standards-

The most frequently applied standards for the testing and certification of above ground storage tanks are those developed by UL or Underwriters Laboratories. Most local and national codes regulating the installation of AST's reference UL standards.

Steel Tanks-

UL 80- Steel Tanks for Oil-Burner Fuels and Other Combustible Liquids.

UL 142- Steel Aboveground Tanks for Flammable and Combustible Liquids

UL 2080- Fire Resistant Tanks for Flammable and Combustible Liquids

UL 2085- Protected Aboveground Tanks for Flammable and Combustible Liquids

Nonmetallic Tanks-

UL SU 2258– Nonmetallic tanks for oil-burner fuels and other combustible liquids

2) Standards that include fire testing or equivalent tests

Steel Tanks-

UL 2080 and UL 2085 use a 2 hour high temperature oven test to simulate an actual pool fire test environment and the heat flux associated with a fully developed hydrocarbon pool fire. The high temperature oven is used rather than an actual pool fire test for repeatability and as a safety precaution.

Nonmetallic Tanks-

UL SU 2258- teste requirements include a 30 minute hydrocarbon pool fire test

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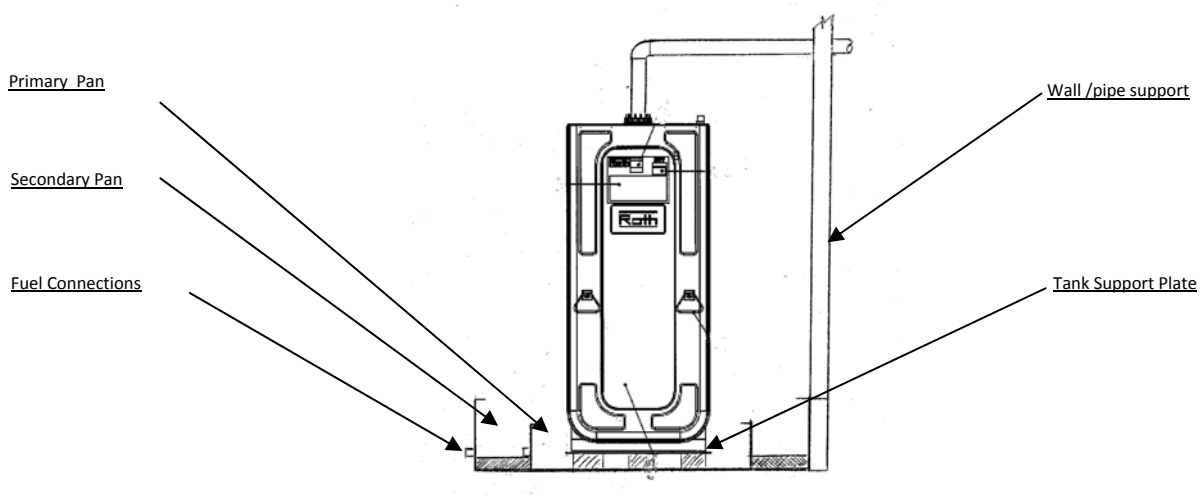
TB 029-15 Lube Oil Storage Tanks-Fire Testing

3) Tank fire test methods

Pool fire test-
The fire test method included in UL SU 2258: The pool fire test apparatus consists of a primary and secondary fire pan and a tank support plate. It may also include a back wall to simulate tank installation in an indoor installation against a wall or bulkhead. The primary pan depth is typically 8 inches deep and exceeds the tank footprint by 6 inches in length and width. The secondary pan is 12 inches deep and is used as a safety containment in case of primary pan failure or spill-over of fuel from the tank. It is normally 8 x 10 ft in length and width and may be partially filled with aggregate or absorbent to control the spread of any fuel spilled during the test. The following sketch illustrates a typical pool fire test rig in cross section.



The primary pan is partially filled with water and then a volume equal to approximately 1/8 inches of level of fuel is added and accumulates on the surface. The test tank is filled to 50% capacity with the same fuel. An accelerant i.e. heptane is used to ignite the fuel in the primary pan, and fuel can be added to the pan throughout the test duration to maintain flame temperature and burning rate. At the end of the prescribed test duration, the fire is extinguished and the test tank evaluated. Sensors are used to monitor tank temperature, flame temperature and tank pressure during the test. Test rig dimensions and configuration may vary with tank shape.

Crib Fire Test-
In Europe and other locations outside of North America, a wood crib fire test is used by product testing and certifying agencies. This test is based on installing the tank in a test chamber and placing stacked cribs of wood directly adjacent to the long side of the tank.

TB 029-15 Lube Oil Storage Tanks-Fire Testing

3) Tank fire test methods continued

Crib fire testing continued-
Wood species is selected according to test protocol and is dimensioned and dried to a prescribed moisture level. The following test rig configuration is from a comparative test run in Canada between a Roth DWT and an obround UL 80 single wall steel tank in the late 1990's.

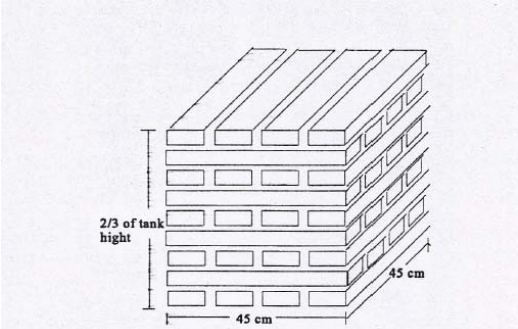


Figure 1
Stack construction

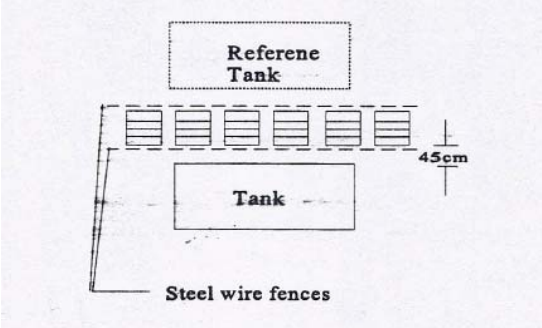


Figure 2: Typical test lay out

In this test, the wood cribs were set in a pan and heptane was used as an accelerant to facilitate ignition. The tanks were filled 75-100% with a 50/50 mixture of water and fuel. Sensors were used to measure tank shell temperature and pressure. After ignition, considerable time elapses before the heat source temperatures reach their maximum levels and later as the majority of the fuel is consumed, the monitored temperatures indicate that cooling has commenced.

4) Comparison of test methods-
Industry and the regulatory community generally find the pool fire test to be more rigorous and better representative of actual installed conditions than the crib fire test.

Test Method Attribute	Hydrocarbon Pool Fire Test	Wood Crib Fire Test
High uniform test temperature exposure, entire tank surface area	Yes, Fuel under and around tank	No, "one-sided" heat source, large temp gradient
Consistent temperatures and heat flux throughout the duration of test	Yes, test rig replenishes fuel supply as it is consumed	No, fuel supply not likely replenished during test
Maximize test temperature based on monitoring and not controlling combustion	Yes, consistent fuel properties	No, difficult due to inconsistent fuel properties
Possible to obtain consistent , repeatable test results	Yes, consistent fuel properties	No, difficult due to inconsistent fuel properties
Confidence in distinguishing betw een suitable and unsuitable materials of const.	Yes, consistent fuel properties	No, difficult due to inconsistent fuel properties

TB 029-15 Lube Oil Storage Tanks-Fire Testing

5) Fire test protocols for metallic and non-metallic tanks

Steel Tanks-

Interestingly, neither UL 80 or UL 142 steel tanks standards incorporate a fire testing requirement.

UL 2080 (Fire Resistant Tanks) and UL 2085 (Protected Tanks) standards include the requirement for the product to demonstrate capability to withstand the heat flux associated with a 2-hour hydrocarbon pool fire. Rather than an actual pool fire test like that associated with UL SU 2258, the test protocol requires placement of the tank in a test oven maintained at 2000 Def F for two hours. The inner tank is instrumented with temperature sensors, with limits for maximum temperature increase over the test duration.

Non-metallic Tanks-
The Roth DWT as certified is subject to and has successfully completed a pool fire test with a 30 minute duration with the following pass/fail criterion

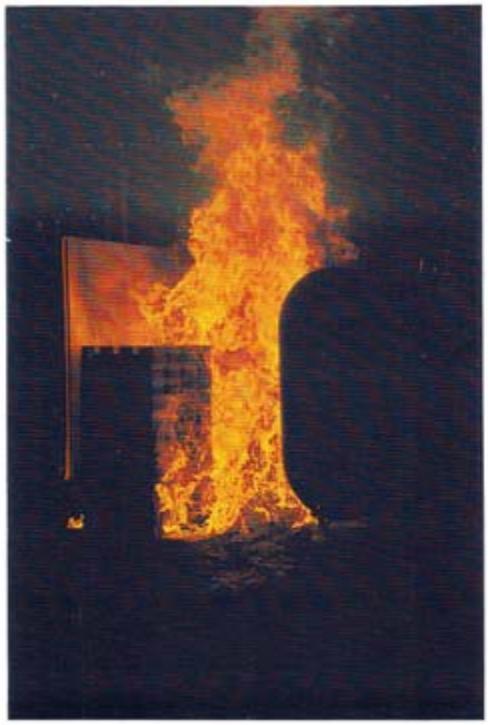
- The test tank shall contain all of the test fuel, even if distortion or melting is present
- The test tank shall not sustain damage which would result in a hazard, such as tip-over or adding fuel to the pool fire
- The primary tank pressure shall not exceed 2.5 psig

The comparative tank testing referred to in section 3 crib fire testing did yield some interesting results concerning the Roth DWT vs. the UL 80 single wall steel tank:

Property	Roth	Steel Tank
External maximum wall temperature (Deg F)	89.6	343
Internal liquid maximum temperature (Deg F)	131	199.4
Noise emitted due to heat stress	No	Yes
Still usable after test	Yes with gauge replacement	Yes with gauge replacement

The Roth DWT maintained significantly lower surface and fluid temperatures than the single wall steel tank during this test!

TB 029-15 Lube Oil Storage Tanks-Fire Testing



For any questions or inquiries regarding this Technical Bulletin, please contact the Roth Technical Department per the contact information below.

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