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Secondary Containment

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Tank inspections, including the length of time between inspections and the type of inspections, are determined by many factors. These include whether the fuel tank is elevated (so all sides of the tank can be inspected), if it is sitting on the ground, whether an impervious membrane is between the tank and the earth (with the earth sloped so leaks will be observed on the low end), and the type of secondary containment (earthen berm, concrete, liner, etc.). The cost of a system requires evaluating both the cost of the containment structure and the cost of inspections. A typically cited standard for steel tank inspections divides the containment structure into Category 1 and Category 2.

Category 1 – Includes secondary containment with a continuous release detection system (CRDS) where releases are visually detected. A CRDS includes methods that do not require sensors or power to operate, such as a liquid containment barrier that is sufficiently impervious to the liquid being stored (for example steel, concrete, and elastomeric liners) that is installed under the above ground storage tank. The liquid containment barrier diverts leaks toward the perimeter of the tank so they can be easily detected and prevents liquid from contaminating the environment until clean-up occurs.

Also included in Category 1 are elevated tanks, where all sides of the tank can be observed for leaks. It also requires a liner or a low permeability soil such as clay with a deep water table to minimize the risk of contamination of the environment until clean-up occurs.

Category 2 – Includes secondary containment such as an earth berm or dike without the release detection system, such as fuel tanks sitting on the soil or a gravel layer, without an impervious material under the tank. Leaks cannot be visually observed in Category 2.

Following is the Steel Tank Institute standard for tank inspections based on the type of secondary containment.

Steel Tank Institute SP001 Inspection Schedule, July 2006

P - Periodic Inspections by owner
E - Formal external inspection by certified inspector
I - Formal interior inspection by certified inspector
L - Leak test
(Frequency of inspection in years)

Above Ground Storage Tank Size (US gallons)	**Category 1 (Elevated tanks with CRDS* and those with an impermeable barrier such as concrete, steel, or synthetic liner)**	**Category 2 (Tanks sit on the ground without impermeable layer)**
0 – 1,100	P	P
1,101 - 5,000	P	P, E (10), L(10)
5,100 – 30,000	P, E (20)	[P, E(5), L(10)] Or [P, E(10), I(20)]
30,100 – 50,000	P, E(20)	P, E (5) & L(5), I(15)

*CRDS – Continuous Release Detection System

The entire secondary containment system, including walls and floor, must be capable of containing oil so that any discharge from a tank or pipe will not escape the containment system before cleanup occurs. Diked areas must be sufficiently impervious to prevent oil from reaching water before the spill is cleaned up.

Clay or other low permeability soil (at least 35% clay) should be used for earth berms or dikes. Normally, at least a width to height ratio of 3 to 1 is required for the berm to develop the dike strength and durability needed. Top soil should be removed and the clay compacted to form a stable berm. Earth berms or dikes will require more area for secondary containment than if vertical walls are used. The floor of an earth berm containment should consist of a low permeability soil such as clay.

Any synthetic or elastomeric liners need to be installed according to manufacturer's recommendations. Frequently a layer of sand is required above and below the liner to minimize the potential for punctures in the liner. Concrete containment will need to be appropriately designed to carry the load of the fuel tanks and to seal joints or other openings.

If the secondary containment is impervious to water, water will need to be removed by pumps; however, you must manually activate these pumps and must inspect the condition of the accumulation before starting, to ensure no oil will be discharged. Pipes through the wall may be used to drain the rainwater, but sealing around the pipe may be difficult and the pipe must have a manually operated value that is normally closed.

Secondary containment must hold fuel from the largest tank and rain from a 25-year 24-hour rainfall event. A 25-year 24-hour rainfall event ranges from 3.5 inches in western North Dakota to 4.2 inches in the southeast corner of the state. The volume of the largest tank is its maximum capacity. The volume displaced by other storage containers within the containment area must be considered when calculating containment volume required.

Fuel tanks must be 10 ft. from property lines, 5 ft. from occupied buildings, and the tanks must be separated by at least 3 ft., according to North Dakota Guidelines included in "Farm Fuel Tank Safety Guide" from the North Dakota Department of Emergency Services.
http://www.nd.gov/des/uploads%5Cresources%5C510%5Cfarmfueltanksafetyguide.pdf
It is also recommended that there be three feet between the tank and containment wall to permit movement for inspection or working with the tanks.

Helpful information on planning secondary containment including tables for tank volumes is included in chapter 7 of MWPS-37 "Designing Facilities for Pesticide and Fertilizer Containment."

Calculations of volumes can be simplified by assuming a circular or rectangular shape for all tanks and containment structures.

Rectangle Volume (cu. ft.) = length (ft.) x width (ft.) x height (ft.)
Rectangular Area (sq. ft.) = length (ft.) x width (ft.)
Circular Volume (cu. ft.) = 0.785 x diameter (ft.) x diameter (ft.) x height
Circular Area (sq. ft.) = 0.785 x diameter (ft.) x diameter (ft.)
Conversions: 1 cu. ft. = 7.48 gallons

Example:

Design earthen secondary containment to hold a 5,000 gallon 8 ft. diameter vertical tank and a 3,000 gallon 8 ft. diameter and 8 ft. long horizontal tank in central North Dakota.

The containment must hold the fuel from the largest tank, so must contain 5,000 gallons of fuel.
It must also hold rainwater from a 24-hour 25-year event, which for this example will be 4 inches. The volume required for the 5,000 gallons of fuel is 5,000 / 7.48 gal per cu. ft. = 669 cu. ft. The required area with a 2 ft. containment wall would be 669 / 2 = <u>334 sq. ft</u>.

The additional volume required for the rainfall is 334 sq. ft. plus the area of the two tanks.
Area of the vertical tank is A = 0.785 x 8 x 8 = 50 sq. ft. Area of horizontal tank is A= 8 x 8 = 64 sq. ft.
The volume for rainfall is (334+50+64) x (4 inch rain /12 inches per foot) = 149 cu ft. For a two-foot wall this increases the required area by 149 / 2 = <u>75 sq. ft.</u>

To simplify the calculation for the displacement of the horizontal tank, a rectangular area 8 ft. by 8 ft. is assumed. This would be an area of 8 x 8 = <u>64 sq. ft.</u> This over estimates the volume required. Referring to Table 7 on page 29 of MWPS-29 shows that the displaced volume is 79 cu. ft. The volume using the 64 sq. ft. area with a two foot depth is 128 cu. ft. The calculations of displaced volume of a round horizontal tank are cumbersome, so refer to a table or use the simple calculations knowing it will over estimate the value. (79 cu. ft. from table for horizontal tank vs. 128 cu. ft. from rectangle.)

The total area required is <u>334</u> + <u>75</u> + <u>64</u> = 473 sq. ft. This might be an area 25 ft. x 19 ft.

The earthen dike requires a height to width ratio of 3 to 1, so it would be 2 ft. tall and with a base at least 6 ft. wide. To permit some freeboard, the secondary containment area would be within the base of the dike. The dike and containment floor would be constructed of clay, with top soil removed from the containment area to minimize permeability.

Rainwater would soak into the containment area, so a means of removing water from within the containment area would not be required.

This would be classified as a Category 2 containment because the tank sits on the ground, so inspection by a certified inspector would be required every ten years.