Chapter 3

FUEL STORAGE TANKS & PIPING

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Accompanying audio files are available at *Learning.NORAweb.org/manual*

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Introduction

The comfort, cleanliness and efficiency of today's systems rely on clean, uncontaminated fuel reaching the burner.

To achieve this:

- Install tanks properly.
- Maintain tanks by regularly inspecting them and fixing minor defects as soon as they are detected to deter further problems.
- Replace aging tanks before they fail.

The proper installation of a fuel tank is a relatively easy process, provided it is installed in accordance with the manufacturer's instructions and applicable codes and regulations are followed.

Local codes normally require that tanks be installed in accordance with their regulations, typically based on the National Fire Protection Association (NFPA) or the International Code Council (ICC). It is best to check with the local authority having jurisdiction to determine which regulations need to be followed.

This chapter gives an overview of fuel tanks. For more detailed information, we recommend reading NORA's manual, *Heating Oil Storage Tanks.*

Why tanks fail

The most common cause of failure is corrosion—the deterioration of the tank due to reaction with its environment.

External corrosion is caused by electrical activity that occurs between different parts of the tank, between the tank and its piping, or between the tank and other metals in the area. For external corrosion to occur, there needs to be:

- An *anode*—something to give up electrons (the tank).
- A *cathode*—something to accept the electrical flow (piping, metals in the ground, etc.).
- An *electrolyte*—something for the electricity to travel through (water).

There is not much that can be done to prevent external corrosion in existing unprotected underground (buried) tanks. Later in this chapter, we will show the types of tanks that can stand up to the corrosion factors that exist underground.

To reduce exterior corrosion for aboveground tanks, make sure:

- The tank has clearance on all sides so that debris cannot accumulate and hold moisture against the tank.
- There is sufficient clearance under the tank so that plant growth does not come in contact with it.
- Scratches and rust are repaired immediately.
- If appropriate, the tank is painted on a regular basis.

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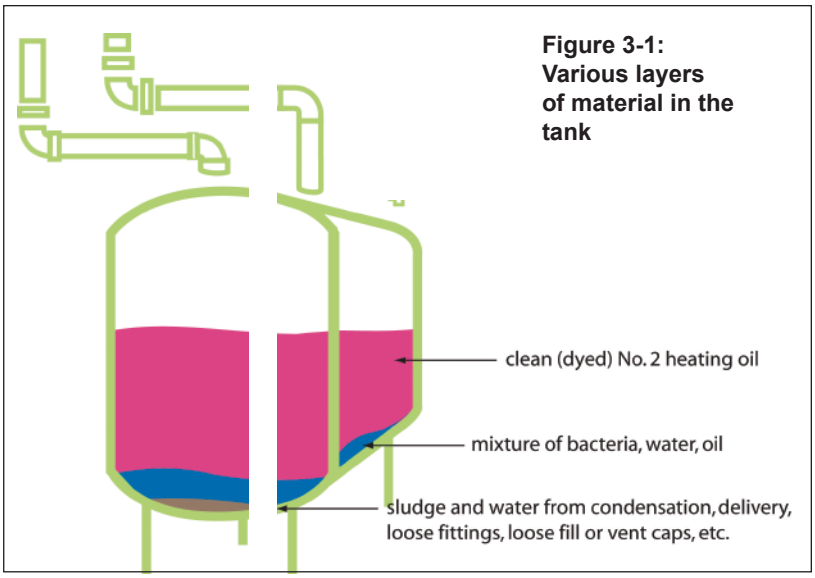

Figure 3-1: Various layers of material in the tank

Internal corrosion is caused by sludge produced by bacteria. For internal corrosion to occur at the tank bottom, there needs to be bacteria and water in the tank, see Figure 3-1.

The bacteria live at the fuel/water interface. They "eat" the fuel and create a substance that, when mixed with water, creates an acid that corrodes the metal in the tank, Figure 3-2.

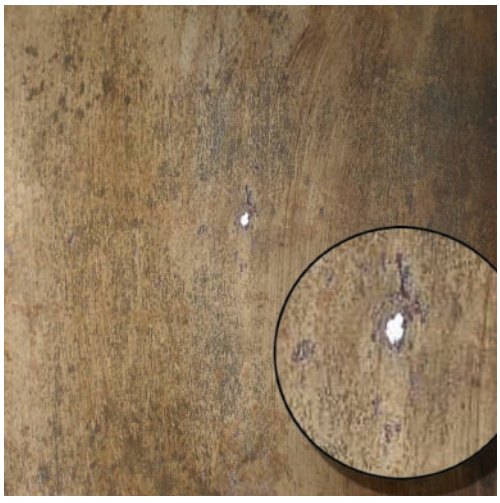

Figure 3-2: Internal corrosion with pin hole magnified

The best way to reduce internal corrosion is to eliminate the water at the bottom of the tank. Removing the water is just the beginning. The technician should then determine how the water got into the tank and take corrective steps to prevent water from building up again. Figure 3-3.

Figure 3-3: Missing vent cap may be a source of water in the tank

The most common causes of water in tanks are:

- Condensation
- Broken tank gauges (outside tank)
- Loose or missing fill and vent caps
- Pumping fuel from an old tank into a new tank
- Failing to drain water from a tank before installation

Condensation can be greatly reduced by installing tanks indoors or in an enclosure. If a tank is located outside, reduce condensation by painting it a light color and protecting it from direct sunlight.

Gauges and caps should be inspected regularly and replaced when necessary.

Following manufacturer's instructions

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when installing new tanks and performing the inspection procedures described at the end of this chapter will greatly reduce the amount of water-related problems and extend the lives of customers' tanks.

Properly installed and maintained tanks can last for several decades—much longer than most equipment in the home. However, like everything else, tanks eventually need to be replaced.

Installation considerations

When it is time to install a new or replacement tank, answer these three questions:

- What size tank will be best?
- Where is the best place to install it?
- What type of tank will be best?

Size

Although large tanks are often installed for delivery efficiency, an oversized tank can cause service problems such as:

- Poor fuel quality—fuel has a shelf life and deteriorates over time
- Corrosion—larger tanks usually build up more water from condensation

However, tanks that are too small require frequent deliveries leading to problems during peak delivery season.

In general, the right size tank is one that holds about one-third (1/3) of the customer's annual consumption. Therefore, a customer who uses 900 gallons of fuel a year should have a 275 or 330-gallon tank. (900/3 = 300).

There may be special situations that require installing a tank that is either larger or smaller, but in general, it is best to apply the 1/3 rule when possible.

Location

There are three possible locations for a tank installation:

- Inside a building—usually in the basement, utility room or garage
- Outside, above–ground
- Outside, underground

Before selecting a tank location, be sure to consider regulations regarding setbacks from:

- Heating equipment and other ignition sources
- Property lines
- Buildings, doors, windows, vents and air intakes
- Meters

Also remember to locate the tank where:

- The delivery vehicle can safely park during filling
- It will be accessible for inspection and servicing
- A fuel release will not easily enter a drain, well or waterway
- It will not be exposed to corrosion and/or damage from dripping water, falling ice, vehicles, etc.

Inside tanks

NORA recommends above ground, indoor tank installations whenever possible. These installations offer many advantages over outside tanks, including:

- The fuel is usually warmer, which means it burns better and will not gel or have cold weather performance problems
- There are fewer temperature changes, which means the fuel will last longer.

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- If a leak develops, the fuel odor will be an alert to the problem.
- It is easier to inspect.
- Less condensation in the tank.

It is important to follow codes and instructions regarding:

- Distance from the tank to the burner (At least 5 feet).
- Size and height of the vent pipe.
- Size of the fill pipe.
- Fusible valve at the tank.
- Fusible valve at the burner.

In addition:

- The fill and vent lines must be pitched toward the tank.
- All tanks should have a vent alarm.
- All tanks should have a tank gauge.
- All systems should have a fuel filter; it can be located at the tank, at the burner or at both the tank and burner.
- The copper fuel line from the tank to the burner (shown here running under the floor) should not touch concrete or soil. This can be done by sliding the copper fuel lines into plastic conduit or plastic pipe or by using a coated copper line.

There should be no fittings in the copper lines below the floor. Figure 3-4.

Above-ground outside tanks

If there is no room for a tank inside the

Figure 3-4: Typical indoor installation

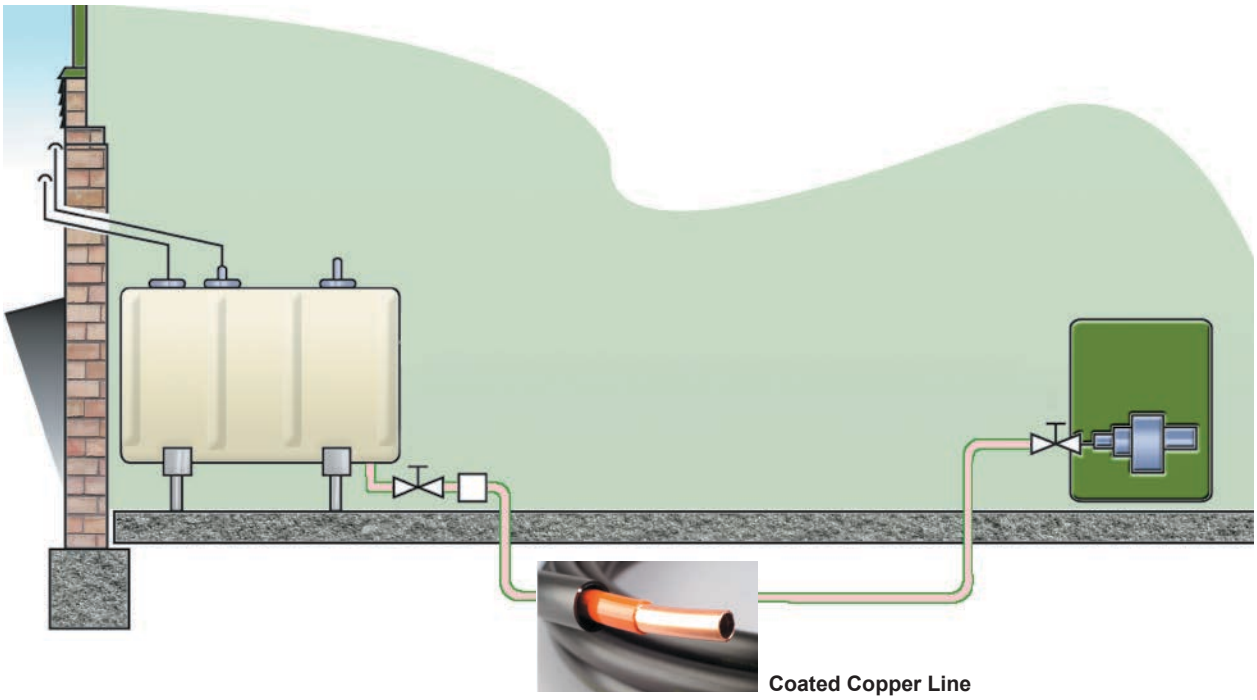

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Figure 3-5: Outside above ground tank. NORA recommends painting outdoor tanks a light color to reduce extreme temperature swings. Inset: tank enclosure

building, it must be installed outside, see Figure 3-5. In these cases, it is a recommended that the tank be installed in secondary containment or in an enclosure to protect it from the elements.

The fuel line can be connected either through the top or the bottom of the tank depending on local weather conditions and company policies. It should be insulated from the tank to where it enters the building. Once the line is inside, it should be connected to a thermal shut-off valve. The fuel filter should NOT be installed outside. It can be installed right after the valve where the line enters the building or at the burner.

Underground tanks

Environmental regulations and insurance concerns have greatly reduced the number of in-ground installations, Figure 3-6, and many homeowners with buried tanks have replaced them with above-ground tanks.

Unless there is no acceptable location available, NORA recommends that all new tanks be installed above ground.

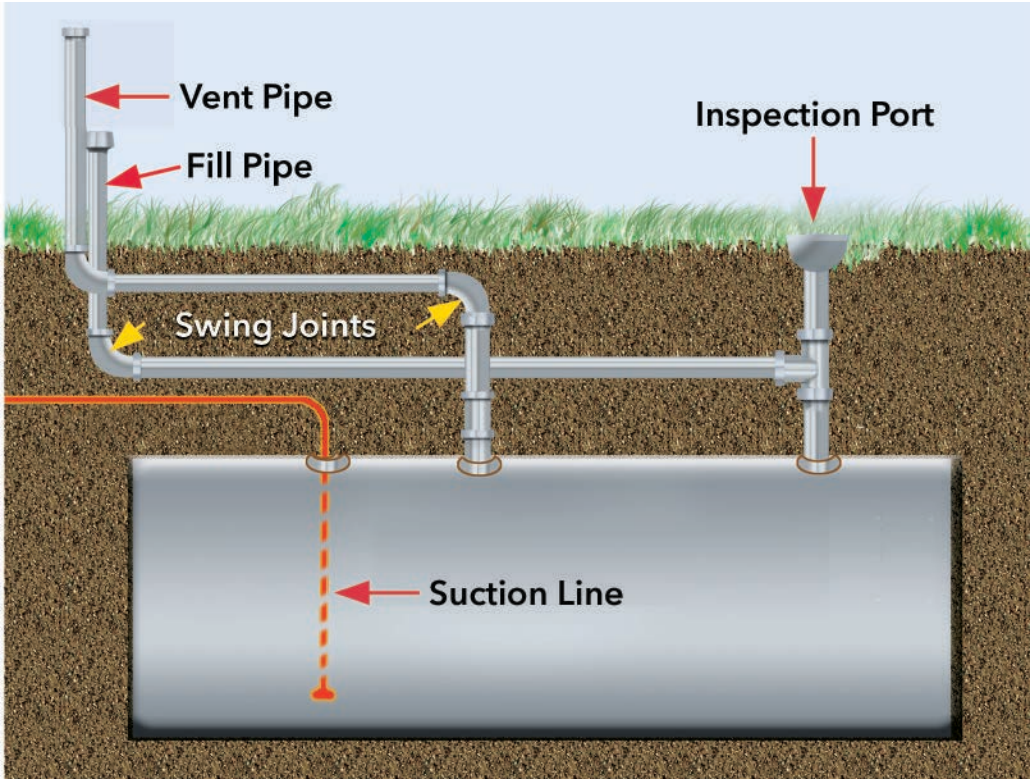

Figure 3-6: A typical underground installation

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Type

Once the proper size and location for a new tank is determined, the customer can choose the type of tank based on price, warranty and level of spill protection. There are many choices:

Above ground tanks

Standard ob-round—The 275-gallon "ob-round" steel tank, Figure 3-7, has been the standard for decades and is the most common tank. Ob-round tanks are currently available in a variety of sizes, from slightly over 100 gallons to 330 gallons.

Figure 3-7: Ob-round tank

Newer ob-round tanks have the fuel drawn from the bottom of the tank to reduce the amount of condensation and sludge build-up in the tank. Figure 3-8.

Figure 3-8: Bottom tap

Externally coated ob-round—This corrosion resistant tank has a polyethylene coating on the outside of a standard ob-round tank, Figure 3-9. The coating protects the tank from external corrosion.

Figure 3-9: Externally coated tank

Double bottom ob-round—This tank has a second bottom to contain a leak should internal corrosion create a breach of the primary tank, Figure 3-10. A sensor installed in the interstitial space triggers an alarm and notifies that the inner tank has been compromised.

Cylindrical—These tanks are often found in mobile homes and in places where

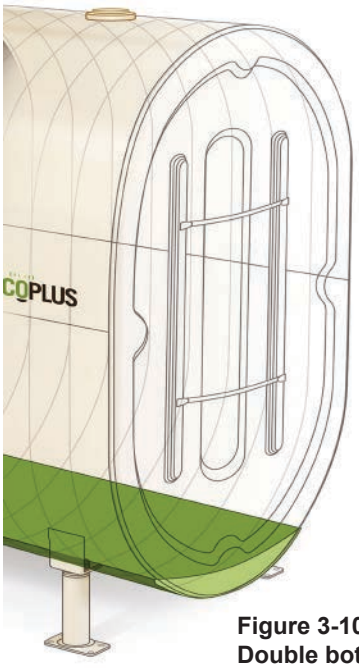

Figure 3-10: Double bottom ob-round

space considerations made it easier to install and service than an ob-round tank. They are typically available in sizes ranging from 160 to 320 gallons.

Fiberglass—This corrosion proof tank is available in both single and double wall models and in 240 and 300-gallon capacities. The double wall unit is a tank within a tank— if the inner tank leaks, the outer tank prevents a release of fuel, Figure 3-11.

Figure 3-11: Fiberglass tank

Polyethylene/steel—These double wall tanks combine an inner tank made of polyethylene with a steel outer tank. The outer tank protects the inner tank and provides secondary containment. See Figure 3-12.

Figure 3-12: Polyethylene/steel tank

Underground tanks

Steel

Sti-P3—These tanks combine the strength of steel with a factory installed corrosion protection system, Figure 3-13. Sti-P3 tanks feature:

- A protective coating over the steel that prevents external corrosion.
- Sacrificial anodes that protect the steel.
- Nylon isolation bushings that electrically isolate the tank from the fill pipe, vent pipe, fuel lines and other attached piping.

Figure 3-13: Underground steel tank

ACT-100 and ACT-100U—These tanks include a much thicker protective coating and offer protection similar to the Sti-P3 without sacrificial anodes, Figure 3-14.

Figure 3-14: ACT-100

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Fiberglass (FRP)

Fiberglass reinforced plastic tanks never rust because they are made from corrosion resistant materials, Figure 3-15.

Figure 3-15: Fiberglass (FRP) tank

Once the correct size, location and type of tank is determined, become thoroughly familiar with the current version of the manufacturer's installation instructions before beginning an installation.

Installation procedures

Be sure to follow the manufacturer's installation instructions and all applicable codes and regulations during the installation. This next section emphasizes some of the important steps in the tank installation process.

Figure 3-16: Cover work areas

Work neat

Protect the customer's property and the components that are being installed. It is much easier to prevent a mess than to clean it up. Cover work areas with drop cloths, builder's paper or other material, see Figure 3-16.

Piping connections

It is imperative that all connections are made tight and leak proof. All threaded connections should be joined with a pipe compound that is suitable for biofuels. Be careful when applying pipe compound and be sure to wipe away excess compound so it does not get into the tank or fuel lines.

Fill and vent pipes

The fill and vent pipes should be made of schedule 40 steel, be pitched toward the tank, and terminate outside the building at a point at least two feet from any building opening and five feet from any air inlet or flue gas outlet. All steel fittings should be malleable, not cast.

The fill pipe should be clearly marked as a fuel fill. The vent cap should have a screen to prevent bugs from making a nest in the vent pipe, Figure 3-17.

Figure 3-17: Fill pipe should be clearly marked "Fuel Oil" and the vent cap should contain an insect screen.

Vent alarms

All above ground outdoor and indoor tanks must have a vent alarm installed, Figure 3-18. The vent alarm alerts the delivery person that the tank is filled to the proper level. Vent alarms are not

Figure 3-18: Vent alarm

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always required for residential buried tanks because a special filling device (vent-a fills, bazooka, deep fill, etc.) that includes a vent alarm may be used.

Fuel lines

For normal residential use, 1/2" O.D. fuel lines are recommended. Copper fuel lines should be connected with flare fittings. Compression fittings must not be used ("slip fittings", where the fuel line enters the top of the tank, are the exception and are acceptable).

Fuel lines should have as few fittings as possible and all fittings should be accessible.

Thermal shutoff valves

Indoor tanks should have a readily accessible thermally actuated shut-off valve in the suction line at the tank, Figure 3-19. Outside tanks should have a shut-off valve where the suction line enters the inside of the building.

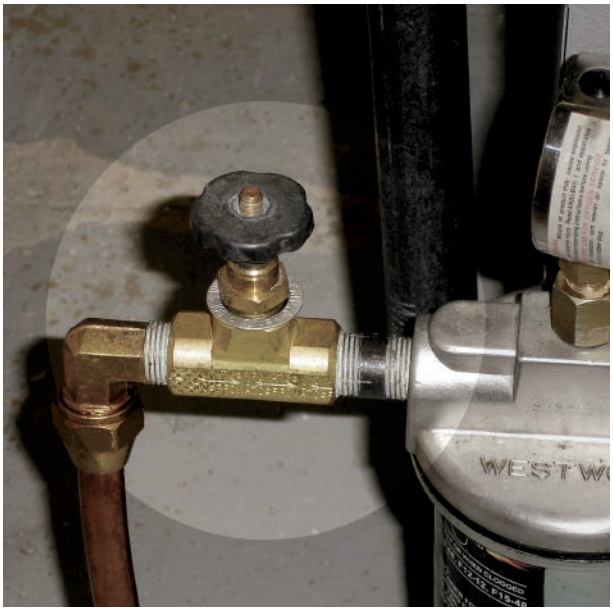


Figure 3-19: Thermally actuated shut-off valve and filter

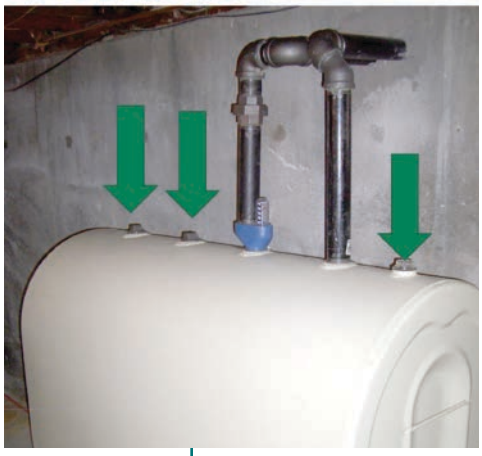
Filters

A fuel filter should be installed in the suction line. See Figure 3-19

Plug or cap

Plastic or metal shipping inserts are used to keep water and debris out of a new tank during shipment and storage. They must be removed and discarded during installation and any unused tank openings must be plugged with threaded steel plugs. See Figure 3-20

Figure 3-20: Unused tank openings must be plugged with threaded steel plugs



Tank inspection procedures

Tanks should be inspected on a regular basis so potential problems can be discovered and corrected before they affect tank longevity and system performance.

NORA recommends three levels of inspection:

- An initial inspection performed before a delivery is made to a new tank or a new customer
- A routine inspection performed during routine maintenance or tune-ups
- A brief, pre-delivery inspection each time the tank is filled

Initial inspections and evaluations

NORA recommends that all tanks should be inspected and approved for delivery before the first delivery to a new customer or a new tank.

An initial inspection provides the opportunity to notice flaws in the tank not reported by the customer, which may cause a problem in the

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future. It also helps ensure that all piping is properly connected and that the fill pipe is correctly identified.

In those cases where a new tank has been installed for an existing customer, the tank inspection should include procedures to ensure that inactive fill and vent pipes have been removed.

The inspections are different for above-ground tanks and buried tanks.

Inspection of above ground tank

Routine inspections

NORA recommends that additional tank inspections be conducted as an integral part of preventative maintenance tune-ups.

While not as comprehensive as the initial inspection, routine inspections are equally important.

Routine inspections can detect problems that occur after the tank has passed the initial inspection. For example, the tank gauge may have become defective, a tank leg may start to corrode, or another problem may have arisen long after the tank was initially approved for delivery.

In many situations, routine inspections detect minor problems that have recently started and that can be easily corrected before they cause a problem.

Brief, pre-delivery inspection

NORA recommends a "no whistle, no fill policy."

Fuel delivery personnel should perform a brief visual inspection before and after each delivery. While this inspection normally is not documented, it is important that fuel drivers understand the need to verify addresses and check tanks for obvious defects before and after delivery.

Chapter 3: Additional Resources

NORA has compiled a library of additional technical resources for your continued education. Scan the QR code or go to the web address. Check back often, as NORA will continually add content as it becomes available..

You will find:

- Videos
- Technical Bulletins
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