

## **APPENDIX C**

### **TANK BATTERIES**

#### **C - 1. Understanding the Tank Battery.**

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3. From the Well to the Tank Battery.



## The Lease Pumper's Handbook

### Appendix C Tank Batteries

#### Section 1

#### UNDERSTANDING THE TANK BATTERY

The purpose of this appendix is to provide information about basic tank batteries, the purpose of each vessel, where it is installed in the system, what vessels should be installed ahead of it, what vessels should be installed after it, and how to operate most of them with a minimum number of problems.

Two tank batteries, even when they support oil or gas production from the same formation, are seldom alike. The lease pumper needs to be able to approach a vessel, look it over, generally understand what is taking place inside the vessel, and know how it is being used for that particular tank battery. The petroleum industry is flexible in handling special production problems, and an understanding of the problems at a lease site may be necessary to explain why a vessel was installed in a particular fashion that may not be the method normally expected.

Generally, the term *vessel* is applied to all the containment structures in the tank battery. More precisely, only those structures that are pressurized are vessels, while those that are atmospheric are referred to as tanks. Thus, vessels are generally involved in some process, such as phase separation, while tanks are usually storage containers, as in stock tanks. In this discussion of the tank battery, both atmospheric and pressurized vessels are described and the generic term vessel is used unless specifically referring to a tank.

#### C1-1. Openings to Vessels for Lines.

There are six standard vessel openings for line attachment, plus a few special purpose ones. Standard openings are:

- Inlet
- First liquid outlet
- Gas vent
- Drain
- Overflow
- Second liquid outlet

These lines all meet a specific need. Some vessels may have two openings to meet the same need. This may make the vessel flexible for right- or left-hand installations. The opening may be a bolted flange or a welded half coupling, which is a heavy-duty grooved nipple welded to the vessel, such as Victaulic of America fittings.

**Inlet.** The purpose of the inlet is to receive produced fluids. This includes everything that comes out of the well: oil, water, gas, and suspended solids such as sand, salt, paraffin, asphalt, scale or gyp, drilling mud, and a host of other elements and compounds.

Inlets are usually located above the fluid line on either the side of the vessel, as in vertical separators, or on the top, as in some horizontal vessels and stock tanks.

The third location for an inlet line is approximately a foot above bottom when the

vessel serves as an automated surge tank. This is common in automated water disposal tank lines or oil sales lines just ahead of the LACT unit. The inlet line is basic to every vessel.

**Gas Vent.** The purpose of the gas vent is to remove the produced gas. It is usually located at the highest point at the top of the vessel. This line may also contain a safety release or pop valve and a pressure safety rupture plate. The gas vent opening is basic with every vessel.

**Oil outlet.** The purpose of the oil outlet is to remove crude oil from the vessel. This outlet line is located either at the operating fluid level of the vessel or below the fluid level and activated by an indiscriminate float. In stock tanks, this outlet is generally located one foot from the bottom and can be automated or controlled by a valve.

**Drain line.** Vessels have to be emptied occasionally, so a drain is provided.

**Overflow line.** When fluid is flowing into a vessel with no automatic outlet, an overflow line is provided. On tank batteries, this line is used regularly and is often referred to as an *equalizer line*.

**Second liquid outlet.** The purpose of the second liquid outlet is to remove the produced water. This outlet is located near the bottom of the tank. This is an optional line that is installed in three-phase vessels where the fluid is separated into gas, oil, and water.

**Special purpose lines.** There are a host of reasons why a special purpose line may be attached to a vessel, such as oil sales lines,

rolling system lines, etc. Small openings are also provided with many vessels for installing pressure gauges, fluid level gauges, safety alarms, and other attachments. These are discussed with each vessel.

### **C1-2. The Shape and Purpose of Vessels.**

Major considerations in tank battery design include:

- Shape of vessel
- Pressure rating
- Number of phases
- Temperature
- Purpose of vessel

**Shape of vessel.** Vessels may be rectangular, with or without tops. Round vessels may be vertical with a rounded top and bottom, horizontal with rounded ends, or spherical. Each shape has special applications.

**Pressure rating.** As fluid is produced from the well, it may be flowing under high pressure or under low pressure with artificial lift. Regardless of how the well is produced, there must be enough pressure for the fluid to reach the surface, flow to the tank battery, and into the vessels.

Initial vessels in the tank battery are usually pressurized vessels, such as the separator, heater/treater, flow splitter, line heater, and the free water knockout. Separators have working pressures, ranging from a few pounds to many thousands of pounds. Pressurized vessels have rounded corners.

Atmospheric pressure tanks in the tank battery system include the gun barrel (or wash tank), water disposal tanks, skimmer tanks, power oil tanks, slop tanks, and stock tanks. These tanks are designed to operate with a maximum pressure of only a few ounces.

**Number of phases.** A two-phase separator is a vessel that separates the incoming emulsion into two fluids. The gas goes out the top gas line, and the liquid is dumped out of the vessel with an indiscriminate float. Most separators are two-phase vessels.

The gun barrel, the free-water knockout, and the three-phase separator are all good illustrations of three-phase vessels. The incoming emulsion is separated into three fluids. The gas goes out the gas line on the top of the vessel, the oil goes out a line at or near the upper fluid level of the vessel, and the produced water goes out the water line located near the bottom of the vessel.

**Temperature.** Crude oil is heated for any of several reasons. Heater/treaters heat crude oil to assist in removing the basic sediment and water content to a level to be able acceptable to sell the oil. This is the most common use of heat.

Other uses of heat include preventing ice from forming in the system, keeping heavy crude thin enough to make it flow to the tank battery, and keeping paraffin in a fluid state.

**Purpose of vessel.** Each field supervisor is faced with problems unique to that lease, and supervisors may solve the same problem in many different ways. Thus, a vessel in one tank battery may serve a purpose that is not required of that vessel in another nearby tank battery, and a vessel that is adequate for handling a problem at one lease may not meet that need at another.

### C1-3. From the Well to the Tank Battery.

Two types of equipment can be located in the flow line between the well and the tank battery: the line heater and the satellite tank battery.

**Installing a line heater in a flow line.** There are several reasons for installing a line heater in a flow line. Emulsions produced from an oil well may freeze, jell, or solidify and block the flow line. Heat added to the emulsion may keep it in a fluid state until it gets to the tank battery. Some of the produced fluids that may solidify are water that does not contain salt, paraffin, asphalt, and crude oils with a very low API gravity. Occasionally, a line heater must be added even when the tank battery is constructed on the edge of the well location pad.

**Satellite tank battery.** A satellite tank battery is a separate system that may be added to the well or group of wells to serve any of several special purposes. These may include the support of:

- Well testing
- Separating water for disposal
- Separating gas for sale or re-injection.
- Pre-treating oil or water.

Various vessels can be selected to support these functions.

