



Indiana Water Operator Training Manual

Lesson Four – DSL operators



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DSL systems and operators

Both water systems and water system operators receive classifications from IDEM. As discussed in lesson one, a Class DSL (distribution system large) includes systems that meet one of the following:

- (A) Serve a population greater than or equal to ten thousand one (10,001) people, or more
- (B) Consist of the following:
 - (i) Storage tanks
 - (ii) Booster pumps to the distribution system
 - (iii) Mechanical devices for movement of water beyond storage

A grade DSL operator is a certified operator qualified to operate a Class DSS, DSM, and DSL water distribution system after having fulfilled the following requirements:

- (A) Possess a high school diploma or its equivalent
- (B) Meet the qualifications of the certification rule
- (C) Must be able to:
 - (i) maintain inventories
 - (ii) order supplies and equipment
 - (iii) interpret chemical and bacteriological sample reports
- (D) Attain one (1) of the following acceptable work experience requirements:
 - (i) One (1) year in the operation of a Class DSL water distribution system
 - (ii) Three (3) years in the operation of a Class DSM water distribution system
 - (iii) Five (5) years in the operation of a Class DSS water distribution system
 - (iv) An acceptable number of years of experience approved by the Commissioner if gained in operation of a combination of the various classifications of water distribution systems

For persons employed by a DSL, WT3, WT4 or WT5 system, an Operator in Training (OIT) classification is available.

A grade Operator-in-Training (OIT) is available under the following guidelines:

(1) to a person meeting the following:

(A) Currently employed at a public water system with facilities classified as a class WT 3, class WT 4 or class WT 5 water treatment plant or a DSL water distribution system

(B) has fulfilled the qualifications of the certification rule

(2) In accordance with the following:

(A) Until the OIT meets the experience requirement needed for the classification of treatment plant or distribution system where the OIT is accumulating work experience

(B) Operating work must be accomplished under the supervision of a certified operator-in-responsible-charge who must verify to the Commissioner the satisfactory achievement of acceptable experience by the OIT

(C) An OIT may not:

(i) serve as a certified operator in responsible charge

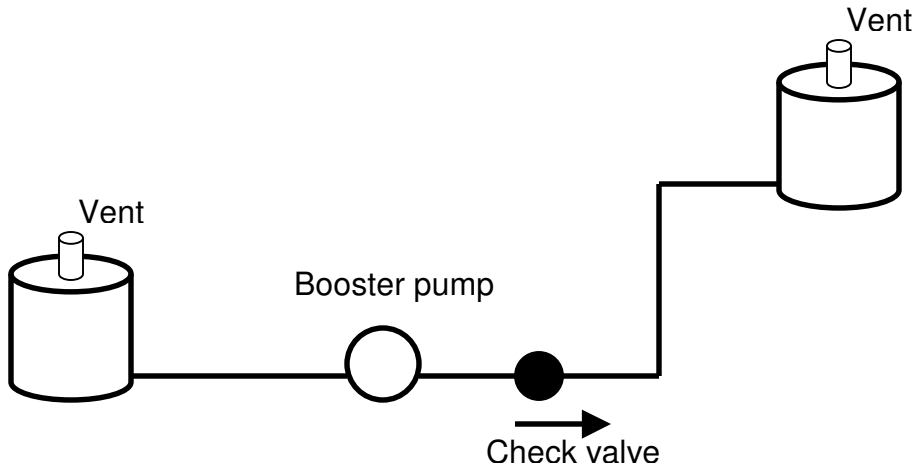
(ii) transfer an OIT certification to a water treatment plant or distribution system with a public water system identification number (PWSID) different than the PWSID for which the certification was issued;

(iii) hold two (2) treatment plant or distribution system OIT certifications concurrently; or

(iv) renew the OIT certification

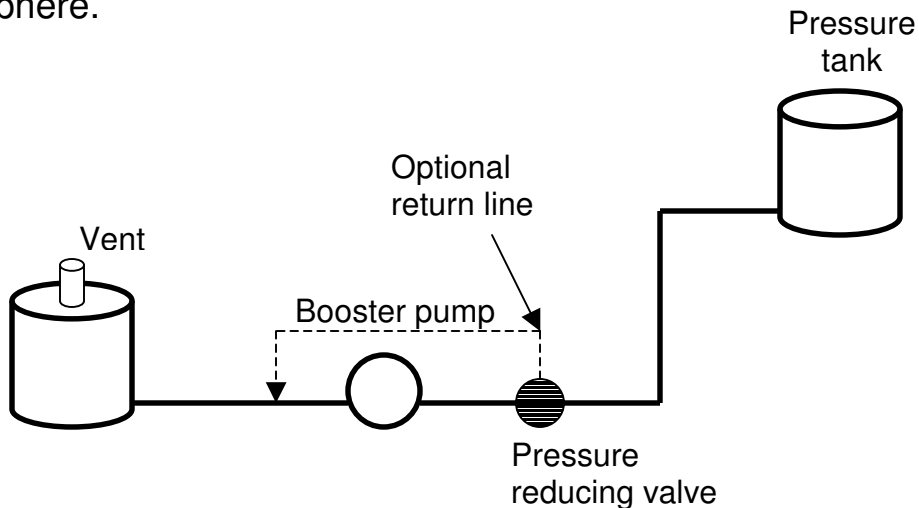
Distribution system booster pumps

In lesson three, a discussion was conducted concerning pressure zones and booster pumps. We learned that distribution systems may have multiple pressure zones (districts). This might happen when a system has a group of customers located at a significantly higher elevation than its other customers. A booster pump will transfer water from the lower zone to the higher zone.



The above drawing illustrates an “open” pressure zone system. Water is pumped to higher-pressure zone that is opened to the atmosphere.

The drawing below shows a “closed” pressure zone system, where water is pumped to a higher-pressure zone that is closed to the atmosphere.



The return line helps prevent over-pressurization and pump damage.

Backflow prevention

Backflow is an unwanted reversal of water flow. There are two types of backflow. “Backpressure” backflow occurs when *downstream* pressure increases or *upstream* pressure drops. “Backsiphonage” backflow is when there is negative (vacuum or partial-vacuum) pressure.

In lesson three, an example of backsiphonage was presented. In that case, a fire department tanker truck pumped water from a hydrant and created a negative (partial vacuum) pressure, sucking pesticides from a mop bucket into the distribution system.

A backpressure scenario might go something like this:

A worker at a factory decides to add water and a corrosion inhibitor, hexavalent chromium, to the cooling water tank. A pump that operates at 70 psi is used. The city water system near the factory operates at a pressure of about 50 psi. The water company does not have a backflow prevention program and there are no backflow prevention devices installed at the factory.

You can imagine the rest of the story. The worker somehow turns a wrong valve and chromium flows into the city’s water distribution system.

Here are some examples of backflow prevention devices:

- Air gap twice the pipe diameter with a 1” minimum is the best protection available
- Reduced pressure principle (RP) backpressure and backsiphonage
- Pressure vacuum breaker (PVB) backsiphonage
- Atmospheric vacuum breaker (AVB) backsiphonage
- Double check valve assembly (DC) for non-health endangering substances

No water system is too small to have a backflow prevention program. Do farmers fill chemical tanks from your water system? A hose hanging into a tank of chemicals or filling the tank from the bottom without a check valve can result in a cross connection that might allow backflow into the water system.

IDEM has prepared a fact sheet on cross connections that may be found in Appendix C of this manual.

Storage tank maintenance

There are at least 30 different types of water storage tanks in use today. Some of the most popular are:

- Welded standpipe
- Concrete standpipe
- Concrete ground level
- Legged
- Pedestal

Please refer to lesson three for a discussion of these basic types of tanks.

Storage tanks represent a significant investment for most water systems. Maintaining a water tank helps ensure a long life, sometimes in excess of 100 years. Let us examine a few tank-maintenance considerations

Safety first

- Stay off your tank if you don't know what you're doing
 - A good superintendent can be harder to replace than an engineer or tank inspector
- Not all safety belts are safe for tank work

- A six-foot fall can break your back with only a waist belt and rope
- Always use the proper climbing equipment
 - Full harness
 - Rail-mounted belt

Vandals

Keep them off your tank with fences, ladder gates and good locks. Sometimes vandals can be fooled. One water system operator, tired of people climbing the tank, simply placed a large “DANGER, HIGH VOLTAGE” sign near the tank. It worked.

Exterior inspection

- Check foundations for cracking, spalling (flaking), exposed reinforcing metal or settling
- Keep vegetation away from foundations
- Trim limbs that may scratch surfaces
- Look for rust stains that may indicate leaks
- Inspect vent and overflow screens for holes or debris
- Check for signs of overflow
- Check for signs of unauthorized entry
- Look for loose bolts/nuts
- Check for paint flaking
- Look for rotation of columns or tower

Interior inspection

Ideally, tanks should be inspected annually. In the real world, this probably is not practical, but an interior inspection every five years or so is doable for most water systems. Here is what to look for:

- Interior roof condition
- Corrosion
- Leaks
- Silt depth
- Cathodic protection system condition

Usually the best interior-inspection method is the dry method, which requires the draining of the tank. A dry inspection allows for the most thorough inspection, but there are disadvantages:

- The tank must be taken out of service
- The interior of the tank can (and should) be cleaned
- A lot of water is wasted
- The method has the greatest potential for tank worker injury
- It is the most expensive method
- Once drained, the tank must be disinfected before returning it to service

A good method of interior inspection is the wet method, using a diver. The method has both pros and cons:

- The tank must be taken out of service
- There is no opportunity to clean the tank
- There is no wasted water
- There is less potential for personal injury to tank workers
- It is not as thorough method of inspection as dry method
- It is less expensive than dry method
- There are some sanitary concerns (customers might not like the idea of someone swimming around in their drinking water)

A fairly new method of interior tank inspection is the remotely operated vehicle (ROV) method. Visualize a cabled-controlled, underwater, motorized device with a floodlight and TV camera. With this method:

- The tank remains in-service
- There is no opportunity to clean the tank
- There is no wasted water
- It has the least potential for personal injury to tank workers
- It is the least thorough inspection method
- It is the cheapest method
- There are few sanitary concerns

Cathodic Protection

Cathodic protection systems are used in the water works industry to protect water storage tanks from corrosion caused by electrical current flow that naturally occurs between dissimilar materials, such as minerals in water and the steel plates of a water tank. Metal from the inside surface of a water tank can flow into the stored water because of the impurities in the stored water.

If a sacrificial piece of metal (an anode) is placed into the water and a reverse current is applied, metal flows from the sacrificial anode into the water instead of metal flowing from the inside wall of the tank.

Remember, cathodic protection is not a substitute for a properly-painted (coated) tank interior. Cathodic protection only helps with the metal that is in contact with the water; not the interior roof and upper sides that do not come into contact with the water.

Be sure to keep current/voltage at recommended settings (check monthly). At 1.2 volts and higher, hydrogen gas may start to form and interior coatings will start to fail due to the bubbling of the gas. Anodes should be inspected and/or replaced annually or as recommended by the manufacturer.

Altitude Valves

Altitude valves are large valves inserted at the base of an elevated water tank, standpipe or reservoir. There are two types of altitude valves.

A one-way valve opens only at one predetermined low level of pressure to fill the storage structure. It closes when a second, higher-pressure level is reached. Water flows in one direction only (into the storage structure). After it closes, it stays closed until the low level setting is again reached. Water is removed through another valve, pipe, pump, etc.

A two-way altitude valve, more common in elevated tanks, allows water to flow in two directions. This valve is adjusted to close when a high-pressure setting is reached. It opens when the maximum pressure is reached. This keeps the tank from overflowing. When the pressure is lower than the high set point, the valve remains open and allows water to flow in and out of the tank.

Altitude valves require minimal maintenance. The most important thing to do is to be sure that the valve and its connecting pipes are free of debris when installed. This writer has found soda cans, rocks, paper cups and lumber inside of altitude valves, left over during construction.

Clogged snubbers cause many problems with altitude valves. Please see the next section for more information about these fittings.

Snubbers

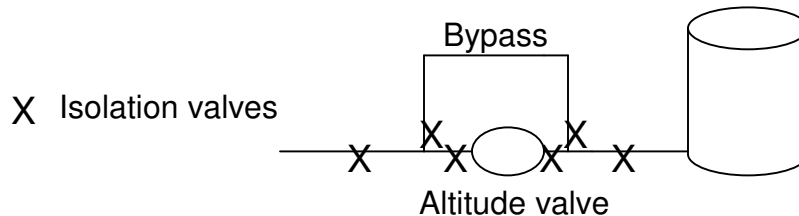
Snubbers are small fittings that restrict flows, preventing rapid pressure changes. Snubbers help prevent “water hammer” damage to gauges and help altitude valves to operate smoothly. Water hammer is a shock wave in a water system usually caused by the rapid closing of a valve.

This phenomenon can be heard in home plumbing when the washing machine water valve turns off quickly. This writer has seen a fire hydrant dislodged from its setting as a result of water hammer in a water distribution system.

There is no regularly required maintenance for these snubbers. When gauges or altitude valves exhibit erratic behavior, check the snubber first.

Isolation valves

Water tank isolation valves are critical to your system. A tank cannot be taken off line (or put it back on line) if the isolation valves do not work. Just like people, valves need exercising.



Vents

Non-pressured storage tanks have vents. These vents allow air to move into and out of the tank as the water level goes up and down. Vents should be screened to prevent debris and animals from entering the tank. Keep vents clear. A tank can buckle if a clogged vent allows a vacuum to be drawn within the tank, much as a soda straw collapses when you are trying to drink a thick milkshake.

Overflow pipes

Elevated storage tanks have overflow pipes connected near the top of the tank and running on the outside to the bottom of the tank and away from the base. The purpose of the overflow pipe is to safely direct overflowing water away from the tank where it will not pond or wash away the tank's foundation.

Like the tank vent, the overflow pipe should be screened. Water must be free to flow away from the tank. The system must be designed to prevent the discharge end of the overflow pipe from becoming submerged underwater. Such a condition would result in a cross connection and could result in backflow into the tank.

Antenna systems

Elevated water tanks can make great platforms for radio antennae. The local fire department or cellular telephone company may want to locate its radio system at your water tank site. Granting such a request can be helpful to your community and might produce some additional income for your water system.

Be careful. A poorly designed/installed radio system can make your tank unsafe to climb and maintain. Here are a few tips to consider before allowing a radio system on your tank:

- Always have a lease agreement
- Never accept the radio system's "standard agreement"
 - Consult with an attorney
- Always employ a qualified engineer to review plans and inspect construction
- Never allow cables to interfere with climbing and safety systems
- Ask yourself
 - Can you repaint the tank and not interfere with the operation of the radio system?
 - Who will remove the system when it is no longer needed?

System security

The three "D"s of security are Deter, Detect and Delay. Intrusion should be deterred, and detected if it occurs. Intruders should be slowed down (delayed) as much as possible to allow more time for their apprehension.

Water system security steps include:

1. Vulnerability assessment

Identify vulnerabilities such as doors, windows, hatches and locations in remote areas.

2. Eliminate or mediate vulnerabilities

Install locks and use them. Install fences, alarms and security lights. Ask for police patrols. Consider asking neighbors to watch over your facilities for you (adopt-a-facility).

3. Emergency response

Know who to call in an emergency. Create a list of emergency telephone numbers.

- Fire
- Police
- IDEM
- Local health department
- Critical users
- Your boss
- Government officials
- Nearby water systems
- Laboratories
- Contractors
- Chemical suppliers
- Parts/equipment suppliers
- Insurance agent
- Local media (radio, TV and newspaper)

Plan ahead for your emergencies. Think about what might go wrong, and try to plan for it. Like a good scout, “be prepared.” Always remember, people come first, then property. Be safe and do not take unnecessary risks.

Congratulations. You have completed lesson four of the Indiana Water Operator Training Manual.

To test your comprehension of the material included in lesson four, a self-graded examination has been prepared for your use. The examination begins on the next page. There are 10 questions that will take a total of about 10-15 minutes to complete. Do not over analyze the questions. Just look for the best answer.

Good luck with the test. You will find the answers in Appendix G-4 of this manual.

There is a Microsoft PowerPoint® slideshow associated with these lessons. The slideshow is located on the compact disc included with this manual.

If you do not have the disc, or would like to view the slideshow on the Internet, you may find it at <http://www.Indianawateroperatortraining.org>.

Indiana Water Operator Training

Self-graded examination

Lesson 4

Check one best answer per question

Question 1.

An open distribution system booster pumps to a higher-pressure zone that is closed to the atmosphere.

- A. True
- B. False

Question 2.

A backsiphonage backflow is caused by:

- A. A drop in upstream pressure
- B. An increase in downstream pressure
- C. A negative (vacuum or partial vacuum) pressure
- D. Both A and B, above

Question 3.

What is the best backflow control device?

- A. Air gap
- B. Double check valve
- C. Reduced pressure principle
- D. Pressure vacuum breaker

Question 4.

A waist belt and rope are the best safety equipment when climbing a water tank.

- A. True
- B. False

Question 5.

Which is the best method for a thorough tank inspection?

- A. Microwave active radio
- B. Dry
- C. Remotely-operated vehicle
- D. Diver

Question 6.

What causes corrosion in a water tank?

- A. Radio frequency leakage from cell phone systems
- B. Chipped paint on the exterior of the tank
- C. Poor electrical grounding of the tank base
- D. Electrical current flow between dissimilar materials

Question 7.

What is a snubber?

- A. The valve that controls the height of the water in the tank
- B. A small fitting that prevents rapid pressure changes
- C. A grease fitting
- D. Part of a cathodic protection system

Question 8.

Ponding near a tank overflow pipe can cause a cross connection.

- A. True
- B. False

Question 9.

When leasing antenna space on your water tank, which of the following should you do?

- A. Never accept the radio system's "standard agreement"
- B. Always employ a qualified engineer to review plans and inspect construction
- C. Never allow cables to interfere with climbing and safety systems
- D. All of the above

Question 10.

The "3 Ds" of security are:

- A. Deter, detect, delay
- B. Detect, disable, detain
- C. Disinfect, discolor, drain
- D. None of the above