Indiana Water Operator Training Manual

Lesson Two – DSS operators

Contents

DSS systems and operators

Both water systems and water system operators receive classifications from IDEM. As discussed in lesson one, a Class DSS (distribution system small) system includes systems that:

(A) serve a population of less than three thousand three hundred one (3,301); and

(B) have no components other than:

(i) pressure tanks; or

(ii) storage tanks

A Grade DSS operator is a certified operator qualified to operate a Class DSS 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) Attain a minimum of one (1) year of acceptable work experience in the operation of a Class DSS water distribution system

If the repeat sample confirms the result of the first test and a maximum contaminant level (MCL) has been exceeded, the water system will need to notify its consumers. Please refer to the Public Notification section of lesson one of this manual for a detailed discussion of when and how to notify the public.

It is important to note that if the first sample indicates a problem with the potential to cause public health concerns, such as biological contamination or the presence of toxic chemicals, the public must be notified immediately. The test results of a repeat sample can take days to determine. That is too long to wait if someone might become ill in the interim.

What you sample for and how often you do it depends in great part upon the size of your water system and the nature of your source water. All systems sample for coliforms, but may be required to sample for many other contaminants.

The Indiana Department of Environmental Management (IDEM) provides water systems with a Standardized Monitoring Framework to let you know what your sampling frequency should be for other contaminants. It looks something like this example.

STANDARDIZED MONITORING FRAMEWORK 2 (SMF 2)

Without Exceeding Detection Limits, Maximum Contaminant Levels, or Action Levels

System Name: Entry Point: 01 PWSID#

<<<< NINE YEAR COMPLIANCE CYCLE >>>>

REGULATED	First Compliance Period			Second Compliance Period			Third Compliance Period		
Contaminants	1993	1994	1995	1996	1997	1998	1999	2000	2001
VOCs	Annual				Annual	1st, 2nd, 3rd Qtr	Annual	Annual *	Annual
SOCs ***	Annual					Annual **			Annual
IOCs		Annual			Annual			Annual	
Asbestos									
PCBs & Dioxin									
Nitrate	Annual	Annual	Annual	Annual	Annual	Annual	Annual	Annual	Annual
Nitrite, Cyanide & Glyphosate									

*** Includes Pesticides

* Regulated and Unregulated VOCs are required in 2000.

UNREGULATED	Third Compliance Period		
Contaminants	1999	2000	2001
VOCs		Annual	

** 2,4-D, Alachlor, Atrazine, and Simazine are required in the first, second, third, and fourth quarter of 1998.

Please contact the Drinking Water Branch at 317/308-3282 if you have any detections or exceed a maximum contaminant level.

Other Monitoring Requirements	1993	1994	1995	1996	1997	1998	1999	2000	2001
Bacteriological	2 per month	2 per month	2 per month	2 per month	2 per month	2 per month	2 per month	2 per month	2 per month
Sodium	One Sample Every Three Years				Annual			Annual	
Lead & Copper	Contact Lilia Park at 317/308-3297 with questions concerning your lead and copper monitoring requirements.								
Radionuclides						Annual			

** Your system detected Hexachlorobenzene and total Xylenes in 1998 and Atrazine in 1999. Please contct our office for your increased monitoring requirements for these contaminants.

Pressure tanks

In many small groundwater systems, the well or wells pump into a pressure tank. The tank performs several functions. It stores water when the demand is low. It gives up water to the system without starting up the well(s) as long as there is sufficient pressure in the tank. It keeps the well pump(s) from cycling too often, which reduces operation and maintenance expense.

There are several types of pressure tanks:

<u>Standard galvanized pressure tank</u>

The simplest galvanized pressure tank works by pumping water into it from the well(s) until the air trapped in the tank compresses to a predetermined pressure, say 50-100 pounds per square inch (PSI).

When the predetermined pressure is reached, a switch turns off the power to the well pump(s). When water is needed, the accumulated air pressure in the tank pushes out the water stored in the tank.

At some point, the air pressure in the tank drops down to another predetermined level, say 25-40 PSI, at which time, the pump switch turns back on and the process starts all over again.

Over a period of weeks or months, the water being pumped in and out of the tank will absorb the air in a pressure tank. The tank becomes “water logged.” A sure sign of a water-logged tank is the frequent cycling of its pump(s).

A slightly different type of galvanized tank has its own air compressor. By running the compressor every once in awhile, the air in the tank can be replenished and too-frequent pump-cycling can be eliminated.

<u>Precharged pressure tank</u>

Similar in function to a standard pressure tank is a precharged one. This type of tank has a rigid float that moves up or down with the flow of water into and out of the tank.

The float helps to decrease the amount of air absorbed by the water, but some air still escapes into the water. An air compressor is necessary to recharge the tank from time to time.

<u>Sealed diaphragm tank</u>

Probably the best type of pressure tank is the sealed diaphragm tank. This tank is designed with a bladder that expands and contracts as water is pumped into the tank and withdrawn from the tank. The problem of water adsorption is almost completely eliminated.

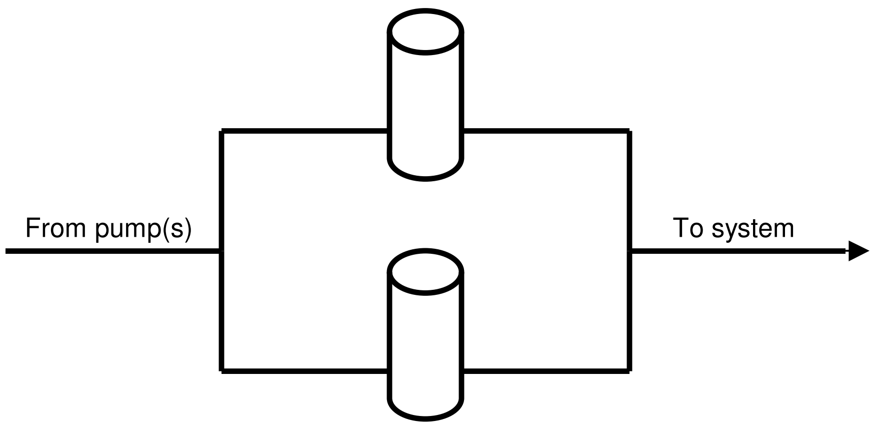
<u>Pressure tank sizing</u>

Pressure tanks need to be properly sized to avoid excessive cycling of the pump(s). A good rule of thumb is 10 gallons of storage for each gallon per minute of pump capacity. Here are some examples:

1. If well pumps 20 GPM, then tank = 200 gallons (10 x 20 = 200)
2. If well pumps 30 GPM, then tank = 300 gallons (10 x 30 = 300)

As a water system grows, it may be necessary to add additional pressure tank capacity. An existing tank can often be replaced with a larger tank, but this may not be desirable for one reason or another.

An alternative to replacement can be the addition of another tank. If you chose this option, be sure to plumb the new tank in parallel to the old tank so water flows equally between both tanks. This diagram shows a parallel layout:



Storage tanks

Water distribution system storage tanks provide a function similar to pressure tanks, but use gravity or additional pumps to provide pressure instead of compressed air. In addition to reducing pump cycling and maintaining pressure, storage tanks can hold large amounts of water that allow systems to meet demands in excess of their pumping capacity for periods of time.

There are two main types of storage tanks.

<u>Ground level</u>

A ground level tank is usually wider than it is high and is located on the surface or just below ground level. If the tank is located at about the same elevation as the wellhead(s), it will need its own pump to deliver water to the distribution system.

If the ground level tank is located at a much higher elevation than the wellhead(s), say on a hilltop above the town, the tank will deliver its water to the system by gravity.

<u>Elevated</u>

Elevated tanks are usually taller than they are wide. If the tank is the same width (or diameter) at the bottom as it is at the top, it is called a standpipe. Visualize it as a pipe turned up on one of its ends.

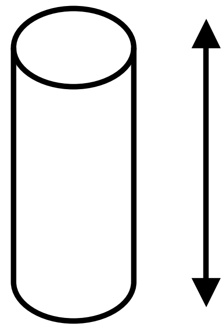
A legged tank consists of a tank supported by several legs spaced at about the width of the tank. A single pipe running up between the legs to the center of the tank provides a path to fill and empty the tank. This pipe is called a riser.

A pedestal tank has a single support running up from the ground to hold the tank. The tank's riser is located within the column. Pedestal tanks sometimes look a little like a huge golf ball on a tee.
As previously mentioned, elevated tanks get their pressure from gravity after the tank has been filled.

The following example will help you to figure out how much pressure a tank can provide at a given height:

1 foot of head (height) = .4333 PSI

2.31 feet of head = 1 PSI

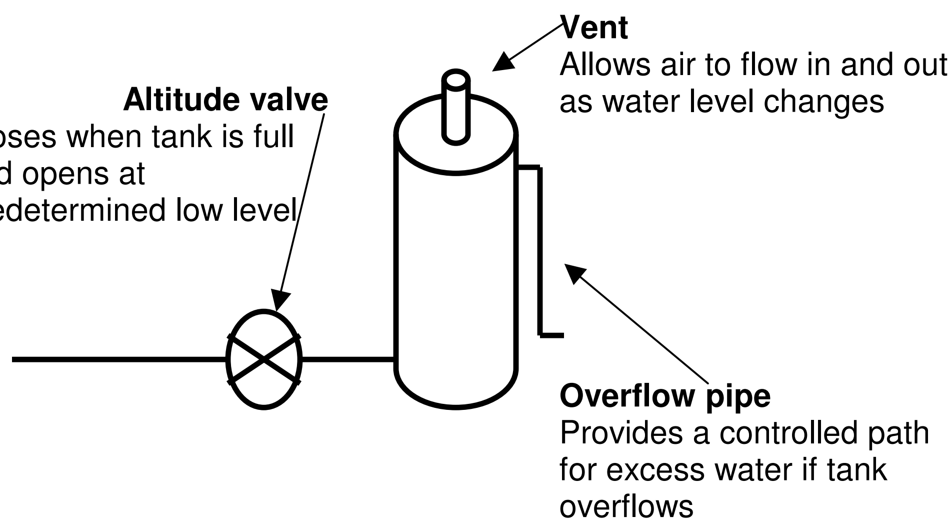


100 x .4333 = 43.33 PSI

If the tank pressure drops to 20 PSI, then there are only 8.66 feet of water in the tank.

$20 \div 2.31 = 8.658$

The following drawing illustrates the typical components of a water storage tank:



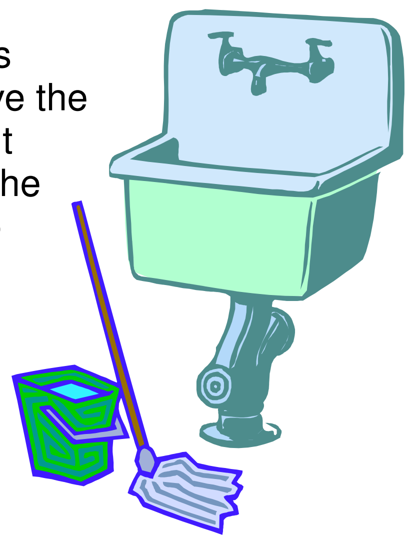
Cross connection control

A cross connection is any actual or potential connection between a public water supply and a source of contamination or pollution. Some examples of where cross connections may occur include:

- Hospitals
- Cooling water tanks
- Mortuaries
- Lawn irrigation systems
- Fire suppression systems
- Mop sinks

It is important to note that while many cross connections do not result in contamination, a water system operator has no way of knowing when and if a cross connection will produce a problem.

Let us look at a mop sink an example of a cross connection.



In the drawing to the right, there is no cross connection because the faucet is well above the highest level of water the sink can hold. But imagine that there is a hose connected to the faucet. That hose runs into the sink or into the mop bucket.

In the above scenario, a cross connection would exist. Even if the faucet is turned off, a cross connection would still be there because the potential for contamination of the water system is present.

Imagine once again that the hose is in the bucket and a maintenance person is mixing up pesticides for use outside. The faucet is on and the hose is filling the bucket, mixing with the pesticides. There is a fire alarm and everyone runs outside.

The fire department arrives on the scene and starts to fill its tanker truck from a nearby hydrant. Because the pressure in the area is low, the fire department turns on a pump to withdraw the water more quickly.

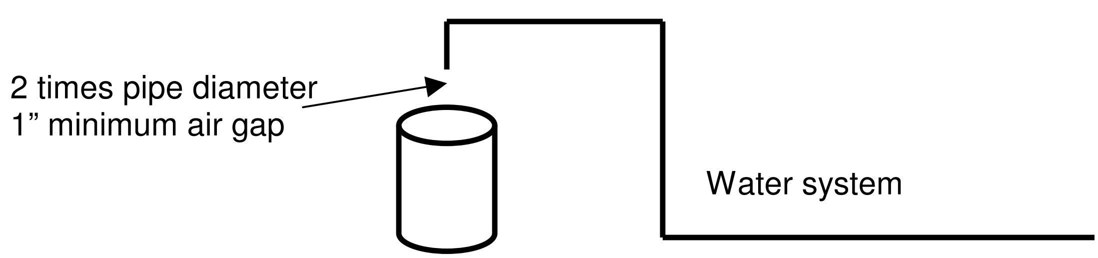
Good news. It is a false alarm. The fire department puts away its equipment and returns to the firehouse and everybody goes back to what they were doing.

The maintenance person returns to the sink and is surprised to find that instead of running over, the bucket is just starting to fill with water. The pesticides seem to have disappeared.

As a careful reader of this lesson, you have probably figured out where the pesticides went. They were sucked up into the water system when the fire department was filling its tanker truck. The cross connection allowed a backflow of contaminants into the water system.

Hopefully, in this case, no one became ill. But what if the sink were located in a hospital, nursing home or daycare center where the special population might be especially sensitive to contaminants?

The above thought exercise illustrates how dangerous cross connections can be. Many cross connections, however, can be easily avoided. An air gap is the best way to prevent cross connections. The gap should be at least two times the diameter of the water pipe near the potential cross connection, and always a minimum of one inch. The following drawing shows an example of this:



For additional information concerning cross connections and backflow control, please refer to lesson four of this manual.

Coliform and nitrate monitoring

Coliform

As we learned earlier in this lesson, coliforms are bacteria that are naturally present in the environment. Fecal coliforms and E. coli come from human and animal fecal waste. Total coliform are used as in indicator that other potential harmful bacteria may be present.

The following shows the frequency of coliform monitoring required for different sizes of water systems:

Population Served	Minimum Number of Samples Monthly
25 to 1,000	1
1,001 to 2,500	2
2,501 to 3,300	3
3,301 to 4,100	4
4,101 to 4,900	5
4,901 to 5,800	6

If a routine sample is unsatisfactory (positive), repeat samples must be taken within 24 hours of notification to the water system by the testing laboratory.

Normal samples per month	Number of repeat samples
1	at least 4
2 or more	at least 3

- 1 sample from location that produced positive
- 1 sample from within 5 connections upstream
- 1 sample from within 5 connections downstream
- 4th sample (if required) from anywhere else from system

If any repeat sample is positive, you must issue a public notification for an MCL violation: Tier 1 (immediate).

All public water systems are required to collect 5 distribution samples during the month after any unsatisfactory total coliform sample.

Here is an example of how that might be accomplished for a system that normally collects one coliform sample per month:

1 sample in May	OK	
1 sample in June	Positive	
4 more samples in June	All OK	
5 samples in July	All OK	
1 sample in August	OK	(back to normal monitoring)

<u>Nitrate</u>

Monitoring for nitrate by community public water supplies is based upon water source (ground or surface) and the levels of nitrate that have been previously detected in the system's water. Samples are obtained from the first place water can be drawn after any treatment, or the tap closest to the well if there is not any treatment.

The MCL for nitrate is 10 mg/l. If the nitrate level is in the range of 10– 20 mg/l, children 6 months and younger may not drink the water, and the public must be informed of this. If the nitrate level is grater than 20 mg/l, continuous public posting with health warnings must be made. In such a case, the system must remediate the contamination.

Appendix F located in the back of this manual contains a fact sheet on nitrate monitoring prepared by IDEM that the reader of this lesson may find useful.

Lead and copper monitoring

All community and nontransient noncommunity water systems must monitor for lead and copper.

Lead

Drinking water may corrode lead-containing plumbing materials such as faucets and solder. Short-term health effects from lead exposure include: interference with red blood cell chemistry, delays in normal physical and mental development in babies and young children, deficits in attention span, hearing and learning abilities of children and slight increases in the blood pressure of some adults. Long-term exposure can cause stroke, kidney disease and cancer.

Copper

Drinking water may also corrode copper-containing plumbing materials such as pipes and valves. Copper is a nutrient that is metabolized by the body. Copper can cause the following health effects: stomach and intestinal distress, liver and kidney damage, and anemia. Persons with Wilson's Disease may be more sensitive than others to the effects of copper contamination.

Action levels

An action level is a level, when the water is sampled, that ninety percent (90%) of samples must be below. The action level for lead (Pb) is 0.015 mg/L. The action level for copper (Cu) is 1.3 mg/L.

Sampling

Lead and copper samples are collected at kitchen or bath cold water taps in homes and collected at drinking water taps in businesses. The water must have been in contact with plumbing for at least 6 hours. This is usually done in the morning and is known as a "first draw."

Initially, samples are collected for two consecutive six-month monitoring periods (January to June and July to December). Sampling is reduced to once per year for three years, and then once every three years.

This chart shows monitoring requirements by system size.

Number of Samples Required for Lead and Copper Sampling

System Size	Initial Monitoring	Reduced Monitoring
> 100,000	100	50
10,001 to 100,000	60	30
3,301 to 10,000	40	20
501 to 3,300	20	10
101 to 500	10	5
< 101	5	5

If an action level is exceeded, the water system should contact the Drinking Water Branch of IDEM immediately. Water quality testing will be required and treatment to reduce the corrosivity of the water may be undertaken. The water system will have to begin a public education program if the lead action level is exceeded.

Chemical contaminant monitoring

All community and nontransient noncommunity water systems must monitor for chemical contaminants. These contaminants include:

- Inorganic chemicals (IOCs) that are naturally occurring contaminants
- Volatile organic compounds (VOCs) that include industrial solvents
- Synthetic organic compounds (SOCs) that are pesticides and herbicides

Exact monitoring requirements for chemical contaminants vary among water systems. Water systems should contact the Drinking Water Branch of IDEM for that system's specific requirements.

Waivers

The Drinking Water Branch may grant a public water system a chemical monitoring waiver if the system meets established criteria for source type, nondetection, vulnerability, population and use of contaminants in the area.

These waivers may cover:

- Use waiver for VOCs and SOCs
- Use waiver for asbestos
- Statewide waiver for PCBs and dioxin
- Susceptibility waiver for glyphosate and cyanide

Distribution system chlorine

If you chlorinate your system, you need to test the distribution system for chlorine. Always maintain a free chlorine residual at all points in the water system of at least .25 mg/l and no less than 1 mg/l total chlorine throughout the system. If .25 mg/l free chlorine cannot be obtained without going a lot over 1 mg/l total chlorine, say > 2 mg/l, look into possible problems such as iron bacteria, ammonia or other organics.

Please see lesson six for more information about chlorination.

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

To test your comprehension of the material included in lesson two, 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-2 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 2

<u>Check one best answer per question</u>

Question1.
What is the minimum number of cliform samples all water systems must collect each month?

___A. 1
___B. 2
___C. 3
___D. 4

Question 2.
A foot of head (water height) produces how many pounds per square inch of pressure?

___A. .4333
___B. 2.574
___C. 3.141
___D. 5.333

Question 3.
Pressure tanks should be sized to avoid excessive pump cycling.

___A. True
___B. False

Question 4.
What is a cross connection?

___A. The process of connecting a hose to the large port of a fire hydrant
___B. Use of an electrically-powered tool in a moist environment
___C. Failure to turn off the power to a well when repacking a gland
___D. An actual or potential connection between a public water supply and a source of contamination or pollution

Question 5.
Under the Lead and Copper Rule, what percentage of tested water services must be below 0.015 Mg/l Lead (Pb)?

___A. 60
___B. 70
___C. 80
___D. 90

Question 6.
What does “first draw” mean when collecting lead and copper samples?

___A. Taking a sample after the water has been in contact with the plumbing for at least 6 hours
___B. Drawing a water sample from the faucet nearest the water meter
___C. Carrying the sample bottle in a leather holster affixed to the technician’s belt
___D. None of the above

Question 7.
In the event you are notified that a coliform sample was positive, how many hours do you have to obtain a repeat sample?

___A. 8
___B. 12
___C. 24
___D. 48

Question 8.
What is the minimum air gap required to prevent a cross connection?

___A. 1 inch
___B. 4 inches
___C. 8 inches
___D. 1 foot

Question 9.
Synthetic organic compounds (SOCs) are found in:

___A. Industrial solvents
___B. Pesticides and herbicides
___C. Naturally occurring contaminants
___D. All of the above

Question 10.
May IDEM grant a chemical contaminant monitoring waiver for asbestos?

___A. Yes
___B. No