

Generator and Pump Tank Treatment Protocols – Biocide, Water Control & Stability

Caution: When working with chemicals, always use proper protective gear. These procedures are for diesel tanks only and should never be used with gasoline tanks that could result in an explosion hazard.

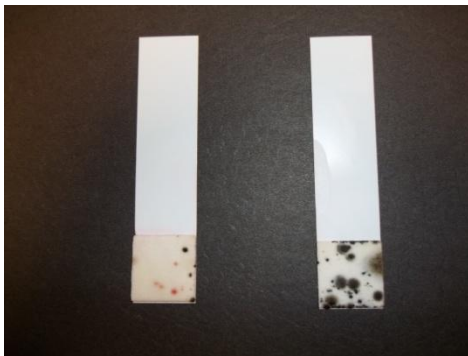
For backup and stand-alone generators and pump systems, keeping the fuel in optimal condition is the most important step towards ensuring the reliability and on-demand usefulness of the system. This will most often involve some combination of treating the fuel for stability, water control, and microbial remediation.

PART I - MICROBIOCIDIC TREATMENT - Recommendations and Procedures For Microbial Growth Control In Tanks Using Bellicide

1) Testing generator fuel for microbiological presence

Confirming the presence of microbes (bacteria, mold, fungus) in generator and pump fuel is an essential step. Undiagnosed microbial presence in the system's fuel supply will lead to greater problems down the road for the system. Confirmation of microbial presence may be done through several ways.

- ✓ The presence of a water phase in the generator's fuel tank, combined with an increase in frequency of filter plugging, AND/OR
- ✓ Darkened fuel and detectable presence of biomass in the unit, AND/OR
- ✓ A positive test using a microbiological culture strip. Culture strips can be acquired from Bell Performance.



***Microbe culture strips,
positive for microbial
presence in fuel.
Fungus (left) and bacteria
(right).***

Microbe culture strips require dipping a prepared strip into a drawn fuel sample and waiting for a 3-day incubation period. A positive test is a strong indicator of the presence of a microbial colony in the fuel.

For those unable to conduct a culture test, the secondary evidences of microbial infestation would be the presence of a water phase in the tank, coupled with increased filter plugging frequency.

If microbial presence is detected or suspected, application of a biocide such as **Bellicide** is the only method capable of eliminating microbes from fuel and keeping them away.



2) Applying biocide fuel treatment to generators and pumps – Two Methods

First time biocide treatments or systems with a known microbe infection should be treated with a double dose of biocide (also known as a shock dose).

A double dose treatment with Bellicide is 1 ounce to 40 gallons of diesel fuel. A maintenance treatment is 1 ounce to 80 gallons of diesel fuel.

Always treat the tank with enough treatment to address a full tank of fuel (as if it were full), so that when additional fuel is added to the tank, the resulting treatment concentration will remain strong enough to treat and kill the dormant microbes lodged on the exposed walls of the storage tank.

A biocide like **Bellicide** kills microbes on contact, but only if it is completely mixed into the fuel. There are two ways of doing this, detailed below. The recommended method for treating generators varies only with the size of the fuel tank. Large backup generation or pump systems may utilize stand-alone fuel tanks of sufficient size to use the below recommendation **IDEAL METHOD FOR LARGE TANKS**. Generators with smaller fuel tanks (tanks too small to utilize a pipe aerator) should be treated with the **IDEAL METHOD FOR SMALL TANKS**.

IDEAL METHOD FOR LARGE TANKS - Using a pipe aerator to mix the biocide into the fuel with an aerator

1. Drop the pipe end of the aerator to the bottom of the tank so it is standing up on the bottom.
Caution: Turn the air valve off before dropping the aerator into the diesel tank.
2. Place a weight on or close the hatch on the air hose so the pipe on the bottom will remain standing upright while you complete the rest of the process.
3. Connect the air valve end to the air supply (preferably another air hose) and not directly to the compressor. Aerating takes about an hour on all large tanks and 30 minutes on 500 gallon or smaller tanks.
4. Allow the compressor to build pressure before turning on the air supply from the hand valve on the air hose. As the pressure drops, shut off the air so the compressor can again build up pressure.
5. Continue this on and off procedure for one hour to insure a proper mix of Bellicide into the diesel fuel.
6. When the process is completed, remove the aerator. **Caution: Make sure you turn the air off before you remove the aerator from the tank. Failure to do this could cause fuel to be forced up the pipe from the tank.**



IDEAL METHOD FOR SMALL TANKS - Using compressed air hose to mix the biocide into the fuel

1. Insert the end of an air compressor hose into the generator tank and lower to the bottom of the fuel tank.
Caution: Make sure the air compressor valve is in the OFF position before starting this process.
2. Secure the hose into position to ensure it does not come out of the tank upon air application.
3. Connect the air valve end to the air supply (preferably another air hose) and not directly to the compressor.
4. Allow the compressor to build pressure before turning on the air supply from the hand valve on the air hose. As the pressure drops, shut off the air so the compressor can again build up pressure.
5. Continue this on and off procedure for 30 minutes to insure a proper mix of Bellicide into the fuel.
6. When the process is completed, remove the compressor hose. **Caution: Make sure you turn the air off before you remove the hose from the tank. Failure to do this could cause fuel to be forced up the hose from the tank.**
7. Let fuel settle for at least 8 hours before use (to allow dead microbes to fall to bottom of the tank).

It is anticipated that most customers with stored fuel will have access to an air compressor. For those that may not have access to an air compressor unit, the recommended backup method follows.

SATISFACTORY METHOD – Using a splash-blending application process

If you do not have an air compressor, or if you are giving the tank a maintenance treatment, you can pour the Bellicide into the hose from the fuel supply truck or pour it directly into the tank **before fuel is added.** This is a splash-blending application process.



3) Maintenance dosage for continued microbe problem prevention

It is very important that a maintenance dose of **Bellicide** be added to the fuel tank every 90 to 120 days. Ultra Low Sulfur Diesel (ULSD) fuel is easily infected with microbes because of the lack of fuel sulfur. The sulfur that was removed for emissions purposes was a natural biocide and was reduced from 500 parts per million to 15 parts in 2006-2007. Instances of ULSD microbial infection have skyrocketed as a result. Therefore, regular maintenance dosage with **Bellicide** is recommended for all ULSD customers.

PART II - WATER CONTROL TREATMENT - Recommendations and Procedures For Water Removal In Generator/Pump Tanks Using DFS Plus

The most essential step to the protection of stored fuel health, both in the short-term and in the long-term, is to control and remove any volume of accumulated water that may have built up in the bottom of the fuel tank. For this purpose, Bell Performance recommends its water-absorbing fuel treatment **DFS Plus**, a commercial-grade water absorber and fuel treatment formulated to absorb and remove accumulated water in all types of stored petroleum fuel used in generator and pump systems.

Determining the optimal course of action for water removal involves three steps:

- 1) Determining water depth and volume in the fuel tank
- 2) Determining the concentration of DFS Plus needed to remove the water
- 3) Proper application of DFS Plus

These steps are discussed below.

1) How to determine water depth and volume in large generator/pump systems

The first step in the process involves confirming the presence of, and determining the amount of, water present in the storage tank. As water is heavier than fuel, any water in the storage tank will be present at the bottom of the tank, below the fuel. The depth of the water phase will determine the volume of water present, in conjunction with the size and shape or design of the fuel tank.

The key difference in this process between large and small generation/pump systems lies in whether the system utilizes a stand-alone fuel tank. Determining the water content in the fuel tank of a large system is relatively easy, because those fuel storage tanks are essentially equivalent in design to typical stored fuel tanks. Small generator/pump systems that don't utilize stand-alone fuel tanks will contain small amounts of water. Recommendations for them follow after the recommendations for large tank systems.



DETERMINATION OF WATER IN LARGE GENERATOR/PUMP SYSTEMS WITH STAND-ALONE FUEL TANKS

To determine water depth, use water-finding paste (available from Bell Performance) and a measuring stick. Apply the water paste along the length of the stick and lower into the tank until it touches the tank bottom. Wait for 30 seconds to allow satisfactory contact time between the water paste and the accumulated water phase. On contact with water, the water paste will change color, enabling a measurement of the depth of the water phase to be determined once the measuring stick is withdrawn from the fuel tank.

To determine water volume, once the water depth is determined, refer to your tank manufacturer's spec chart to equate the depth of water phase with water volume. For your convenience, you can also refer to the Water Volume Chart on the proceeding pages. These Charts are provided for general estimation of water volume according to depth in the most common double-wall cylindrical design tanks with horizontal orientation. To use the Charts, find your tank's diameter (in feet) and maximum volume (in gallons); water volumes by depth are listed for readings up to 6 inches.

If you cannot find your specific tank size in these Water Charts, you can refer to Bell's online tank chart generation tool, located at www.BellPerformance.com/enterURLhere. Simply enter your tank dimensions and receive a custom chart generated for your storage tank measurements, with readings for water depth and volume.

DETERMINATION OF WATER IN SMALL GENERATOR/PUMP SYSTEMS WITHOUT STAND-ALONE FUEL TANKS

Smaller systems are not large enough to need a determination of water depth and calculation of water volume by tank diameter.

To confirm water presence, and depth use water-finding paste and a measuring stick. Apply the water paste along the length of the stick and lower into the tank until it touches the tank bottom. Wait for 30 seconds to allow satisfactory contact time between the water paste and the accumulated water phase. On contact with water, the water paste will change color to confirm water presence. Note the depth of the water phase in the fuel tank by the height of color change on the paste.

To determine water volume, if the generator manufacturer happens to have a specification chart for their unit, refer to that. In the absence of this, use the Water Volume Chart reading for the 4 FT/550 GALLON size tank.

- For example, in a smaller unit, a water depth reading of ½-inch would be interpreted as 2 Gallons of water present.



Bell Performance, Inc. tel 407-831-5021
 1340 Bennett Drive fax 407-331-1125
 Longwood, FL 32750
www.BellPerformance.com
www.WeFixFuel.com

Water Volume Chart - Double Walled Tanks

Inches of Water	4 ft. Diameter Tank Volume (Gallon)			Inches of Water	6 ft. Diameter Tank Volume (Gallon)						Inches of Water	8 ft. Diameter Tank Volume (Gallon)						Inches of Water	10 ft. Diameter Tank Volume (Gallon)		
	550	1,000	1,500		2,000	3,000	4,000	5,000	8,000	10,000		4,000	5,000	8,000	10,000	12,000	15,000		10,000	15,000	20,000
1/8	1	1	2	1/8	2	2	3	4	6	8	1/8	2	2	4	5	6	8	1/8	3	4	6
1/4	1	2	3	1/4	2	4	4	6	9	11	1/4	3	3	6	7	9	11	1/4	4	6	9
3/8	1	3	4	3/8	3	5	6	8	12	15	3/8	3	5	8	10	12	15	3/8	5	9	12
1/2	2	3	5	1/2	4	6	8	10	16	19	1/2	4	6	10	12	15	19	1/2	7	11	16
5/8	2	4	7	5/8	5	8	9	12	20	24	5/8	6	7	12	15	19	24	5/8	8	14	20
3/4	3	5	8	3/4	6	9	11	15	24	29	3/4	7	9	15	19	23	29	3/4	10	17	24
7/8	3	6	9	7/8	7	11	13	17	28	34	7/8	8	10	17	22	27	34	7/8	12	20	28
1	3	7	11	1	9	13	16	20	32	40	1	9	12	20	26	31	40	1	14	23	32
1 1/4	5	9	14	1 1/4	10	17	20	26	42	52	1 1/4	12	16	26	33	40	51	1 1/4	18	30	42
1 1/2	6	11	18	1 1/2	13	21	25	32	52	65	1 1/2	15	19	33	42	50	64	1 1/2	23	38	53
1 3/4	7	13	21	1 3/4	16	25	31	39	64	78	1 3/4	18	24	40	50	61	78	1 3/4	28	46	64
2	8	16	25	2	18	30	36	47	75	93	2	22	28	47	60	73	93	2	33	55	77
2 1/4	10	18	30	2 1/4	22	35	42	54	88	108	2 1/4	25	33	55	70	85	108	2 1/4	39	64	90
2 1/2	11	21	34	2 1/2	25	41	49	62	101	124	2 1/2	29	38	63	80	97	124	2 1/2	45	74	103
2 3/4	13	24	39	2 3/4	28	46	55	71	115	141	2 3/4	33	43	72	91	111	141	2 3/4	51	84	118
3	14	27	44	3	32	52	62	80	129	159	3	37	48	81	103	125	158	3	58	95	133
3 1/4	16	30	49	3 1/4	35	58	69	89	144	177	3 1/4	42	54	90	115	139	177	3 1/4	65	106	148
3 1/2	18	33	54	3 1/2	39	64	77	98	159	196	3 1/2	46	60	100	127	154	195	3 1/2	72	118	164
3 3/4	20	37	59	3 3/4	43	70	85	108	175	215	3 3/4	51	66	110	140	169	215	3 3/4	80	130	181
4	22	40	65	4	47	77	92	118	191	235	4	56	72	120	153	185	235	4	87	143	198
5	30	55	88	5	65	105	126	161	260	320	5	77	99	165	209	253	321	5	121	197	273
6	39	71	114	6	84	136	163	209	336	413	6	100	128	213	270	327	415	6	159	257	355



2) Determining the recommended volume of DFS Plus fuel treatment in large systems

Once the total water volume is determined, a sufficient volume of **DFS Plus** should be added to remove the water. **DFS Plus** is formulated to remediate **2 units of volume of water per unit of treatment**. The exact amount of water the treatment will absorb may depend on environmental factors such as temperature.

To determine the right amount of DFS Plus for treatment, refer to these recommendations.

<i>Volume of Water (Gallons)</i>	<i>Volume of DFS Plus (Gallons)</i>	<i>Volume of Water (Gallons)</i>	<i>Volume of DFS Plus (Gallons)</i>
2	1	24	12
4	2	32	16
8	4	64	32
12	6	110	55
16	8		

3) Proper Application Procedures for DFS Plus

Following best practice procedures for **DFS Plus** application is the final essential step to ensuring the most effective remediation of an accumulated water problem. Refer to this list of best practices for the most effective treatment.

- ✓ Add the recommended volume of **DFS Plus** to the storage tank, on top of existing fuel.

Proper mixing of **DFS Plus** and fuel is essential to the effectiveness of the treatment, as the treatment must contact the water in question in order to absorb it.

- ✓ Ensure adequate mixing of treatment and fuel+water by circulating or aerating the treated fuel. This may be accomplished with an aerating mechanism or an air compressor with hose, depending on the size of the tank.
- ✓ Circulate/aerate the treated fuel for 30-60 minutes, depending on the amount of fuel within the storage tank. Proper circulation for DFS Plus is essential to establishing the required residence time within the fuel, enabling the active ingredient in DFS Plus to contact and absorb the water.
 - For fuel volumes less than 1,000 gallons (which includes all small generator/pump systems), circulate for 30 minutes.
 - For fuel volumes 1,000 gallons and above, circulate for 60 minutes.



- ✓ For detailed procedural steps on this circulation method, refer to the **Ideal Method** description of tank aerating for Bellicide referenced earlier.

Completing the required mixing of treatment and fuel+water will likely “kick up” any sludge or debris from the bottom of the tank. Therefore.....

- ✓ **IMPORTANT: Let fuel settle in storage tank for at least 8 hours before use.**

4) Followup testing and treatment for DFS Plus

- ✓ It is recommended to re-test for water presence every 30-45 days, using the procedures detailed earlier.
- ✓ When water is detected, treat with **DFS Plus** as described.
- ✓ As-needed treatment of accumulated water with **DFS Plus** is your best step towards minimizing potentially serious and costly water-related problems in your stored fuel.

Following these recommendations will maximize your success with **DFS Plus** treatment.

PART III- FUEL STABILITY TREATMENT - Recommendations and Procedures For Stability Treatment Using Dee-Zol Life or Dee-Zol

Controlling accumulated water and killing microbial growths are both essential parts of protecting stored fuel supplies, especially from an acute standpoint. But for long-term fuel quality, it is also essential to treat with a stability treatment like **Dee-Zol Life** or **Dee-Zol**. Treatment with these formulations will halt the chemical chain reactions which start when the fuel is exposed to oxygen, water, light and other catalysts, and which result in:

- ✓ Fuel darkening
- ✓ Fuel stratification
- ✓ Heavy end fallout and sludge buildup

1) Fuel Usage: Regular Use vs. Periodic Use

For generator & pump systems used on a regular basis, treat with **Dee-Zol**, Bell’s multifunction fuel treatment that combines fuel stabilizers, antioxidants, combustion improvers, surfactants and detergents.

For generator & pump systems engaged in only periodic use, treat with **Dee-Zol Life**, Bell’s commercial-grade antioxidant fuel stabilizer for long-term fuel storage.



Bell Performance, Inc. tel 407-831-5021
1340 Bennett Drive fax 407-331-1125
Longwood, FL 32750
www.BellPerformance.com
www.WeFixFuel.com

2) Compatibility with other treatments

Both **Dee-Zol Life** and **Dee-Zol** are compatible with all other fuel treatments, especially the above-referenced treatments for microbe and water control (Bellicide & DFS Plus). Therefore, they can be added at the same time as other treatments. Following the recommended treatment/application procedures for these other treatments would also be appropriate while adding **Dee-Zol Life** and **Dee-Zol**.

3) Treat Rate

Dee-Zol Life: Use 1 gallon of **Dee-Zol Life** for every 2,000 gallons of fuel. This treat rate also equals 1 ounce per 15-16 gallons of fuel.

Dee-Zol: Use 1 gallon of **Dee-Zol** for every 1,280 gallons of fuel. This treat rate is equivalent to 1 ounce per 10 gallons of fuel.

4) Product Application

Follow the same application procedures as for **Bellicide** and **DFS Plus**.

- ✓ Add the recommended volume of **Dee-Zol Life** or **Dee-Zol** to the fuel tank, on top of existing fuel.
- ✓ Ensure adequate mixing of treatment and fuel by circulating or aerating the treated fuel. This may be accomplished with an aerating mechanism or an air compressor with hose.
- ✓ Circulate/aerate the treated fuel for 30-60 minutes, depending on the size of the fuel tank.
- ✓ Let fuel settle in tank for at least 8 hours before use (to let any circulated sludge settle).

5) Re-treatment Recommendations

Dee-Zol Life and **Dee-Zol** are formulated to be a one-time treatment for fuel batches. Once treated, the fuel should not need to be re-treated at any time before use.

If you have any further questions regarding proper treatment and product application instructions for any of the fuel treatments manufactured by Bell Performance, please contact your Bell Performance representative.