

Erosion Chlorinator

Installation and Operation Manual



Item 020030

Item 011117

March 2022

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Important Safety Information

This manual contains important safety, assembly, installation, and operating instructions for the erosion chlorinator.

The following symbols are used throughout this manual to indicate potentially dangerous conditions or important instructions.



WARNING: Indicates a potentially dangerous condition. Use extreme caution when performing this task.



NOTE: Indicates a procedure or function that is important to the safe and proper operation of the system.

1. General Information

1.1 Introduction

This manual discusses the assembly and operation of Water Mission's Erosion Chlorinator for effective chlorination of safe drinking water.

There are three types of contaminants associated with drinking water: microbial contaminants, suspended solids, and dissolved solids. When operated properly on protected groundwater sources, the chlorinator effectively neutralizes microbial contaminants through disinfection.

Chlorination alone is never recommended for surface waters or unprotected water sources due to possible contamination by chlorine-resistant protozoa. In these instances, filtration combined with disinfection is the recommended solution to ensure safe water.

WHAT'S IN THE WATER?		
There are 3 types of water contaminants.		
Contaminant	Description	Solution
1 Microbial Contaminants	Disease causing microorganisms that pose a serious health risk if consumed. There are three types: <ul style="list-style-type: none">– Bacteria that cause illnesses like cholera and typhoid– Viruses like rotavirus and hepatitis A– Protozoan parasites like Cryptosporidium, Giardia, and tapeworms	Filtration and disinfection
2 Suspended solids	Dirt and debris that makes water appear cloudy and dirty, and are often the source of microbial contaminants	Sedimentation and filtration
3 Dissolved solids	Minerals, salts, metals, or ions dissolved in water	Pretreatment or advanced treatment like membrane filtration or reverse osmosis

Figure 1 - Three Types of Water Contaminants

1.2 Intended Use

The Erosion Chlorinator is designed to chlorinate water for safe drinking without prior filtration. This is only recommended on well-protected groundwater sources (e.g. sealed borehole, protected spring) with low turbidity (preferably less than 1 NTU, but up to 5 NTU). Chlorination without prior filtration is never recommended for surface waters or unprotected water sources due to chlorine-resistant pathogens.

1.3 Safety Information

In low doses, chlorine is highly beneficial and can improve health; however, it can be dangerous in high concentrations.

The Erosion Chlorinator uses five, three-inch chlorine tablets. There are several varieties available, all with their own chemical formulation. As long as the tablet is three inches in diameter, it can be used in the chlorinator. One example is calcium hypochlorite, which comes as quick dissolving tablets that can produce high chlorine concentrations. Slow dissolving tablets, like trichlor, make the chlorine concentrations easier to control. Water Mission uses ACL 90 trichlor tablets from OxyChem (see Appendix A for specifications). All operating parameters outlined in this manual are specific to the ACL 90 tablets. Procedures and results may vary if using a different chlorine tablet.



WARNING: Different chlorine varieties should never be used simultaneously. Combining two products could result in a dangerous chemical explosion. If it is necessary to switch to a new type of chlorine tablet, the chlorinator should also be replaced.



WARNING: Direct contact with chlorine can be harmful and should be avoided. Always wear protective gloves when working with chlorine.



WARNING: Chlorine fumes can accumulate in the chlorinator and may be released when draining the chlorinator, removing the cover, or opening the chlorine tablet bucket. Always perform these actions in well-ventilated areas and avoid inhalation of chlorine fumes.

2. Design of the Erosion Chlorinator

The chlorinator is designed to chlorinate water as it flows from the water source to the storage tank as shown in Figure 2. A portion of the inlet water is diverted through the chlorinator where it passes over chlorine tablets, which dissolve into the water. When operated properly, this provides effective chlorination and safe drinking water that exits to the storage tank.

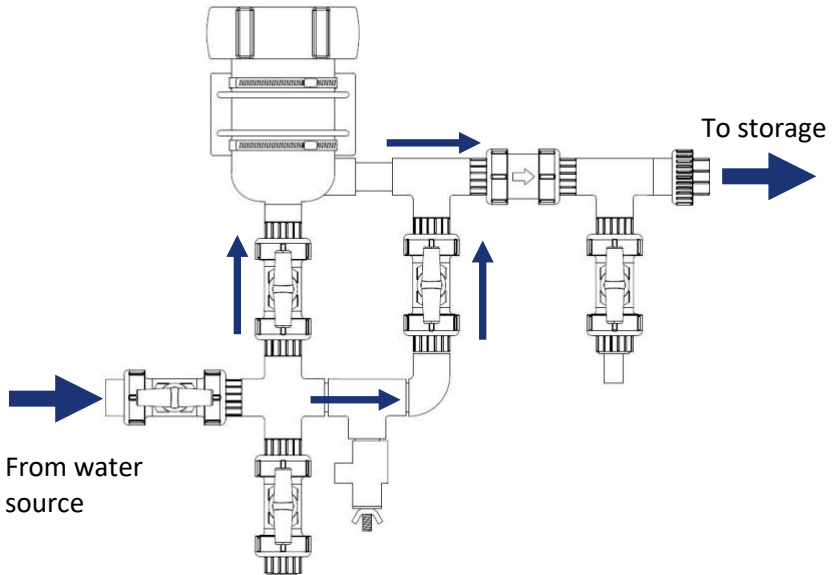


Figure 2 - Diagram of the Erosion Chlorinator (020030)

2.1 Valves and Components

The valves are key in effectively operating the chlorinator. Figure 3 shows each valve on the system, and Table 1 provides a description of the valves and their uses.

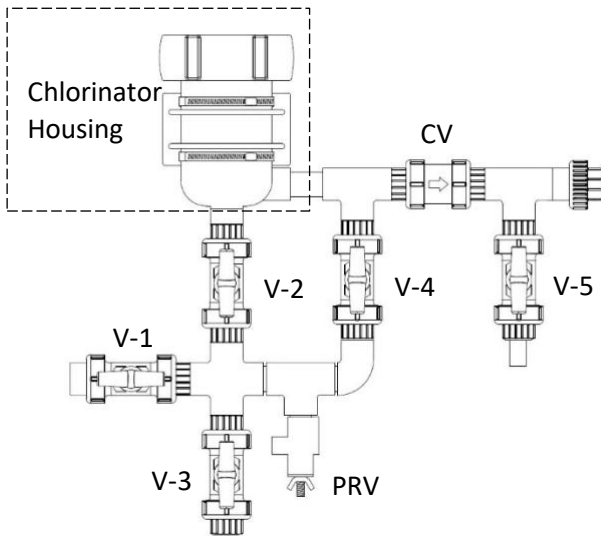


Figure 3 - Valves on the Chlorinator

Table 1 - Description of the Erosion Chlorinator (020030) Valves

Valve	Name	Use/Description
V-1	Flow Control Valve	Controls total flow of water through the system
V-2	Chlorine Control Valve	Controls chlorine concentration by adjusting the amount of water diverted to the chlorinator
V-3	Drain Valve	Used to drain water from the chlorinator when not in use
V-4	Bypass Control Valve	Controls amount of water bypassing the chlorinator
V-5	Sample Valve	Used to collect water samples
PRV	Pressure Relief Valve	Opens if pressure exceeds 85 m (120 PSI) to prevent damage
CV	Check Valve	Prevents water from flowing backwards into the system

2.2 Key Operational Parameters

The Erosion Chlorinator is designed for flow rates of 12-75 LPM (3-20 GPM). For flow rates below 12 LPM (3 GPM), the chlorine concentration becomes more difficult to regulate consistently. For flow rates above 75 LPM (20 GPM), Water Mission recommends installing multiple Erosion Chlorinators in parallel or using an external bypass of the chlorinator. Table 2 shows the effect of flow on pressure loss across the chlorinator.

Table 2 - Key Operational Parameters of the Erosion Chlorinator

Flow Rate		Head/Pressure Loss	
LPM	GPM	m	PSI
12 - 19	3 - 5	0.7 - 2.1	1 - 3
19 - 57	5 - 15	2.1 - 7.0	3 - 10
57 - 75	15 - 20	7.0 - 12.7	10 - 18

The Erosion Chlorinator is available in two models, suitable for different applications and desired pressures. Model EC 75-85 AV1 (020030) is complete with the piping and valves shown in Figure 3 to operate up to pressures of 85 meters (120 PSI). The remainder of this manual focuses on the installation and operation of Model EC 75-85 AV1. Model EC 75-105a (011117) is the independent chlorinator housing as shown in Figure 4, which is designed to operate up to 105 meters (150 PSI).



Figure 4 - Model EC 75-85 AV1 (left) and Model EC 75-105a (right)

Model EC 75-85 AV1 is designed with an internal bypass and can provide total chlorine concentrations up to 5 mg/L. It should be noted that water temperature has the greatest influence on the chlorine concentration exiting the chlorinator. Warmer water will dissolve the tablets at a higher rate, resulting in higher chlorine concentrations. More information on chlorine concentrations is available in Appendix A.

3. Setup

3.1 Unpacking the Erosion Chlorinator

Unpack the assembled Erosion Chlorinator kit to make sure all required parts are included. Figure 5 shows all the items included with the Erosion Chlorinator (Model EC 75-85 AV1, Item #020030). Refer to Table 3 for quantities and descriptions.



Figure 5 - Items Included with the Erosion Chlorinator (020030)

Table 3 - Items Included with the Erosion Chlorinator (020030)

	Quantity	Description
1	1	Erosion Chlorinator (pre-mounted to board)
2	1	Hach Chlorine Test Kit
3	5	Hach Free Chlorine Reagent
4	1	PVC Cement (2 oz)
5	1	PVC Primer (Acetone Wipes)
6	1	O-Ring Grease (Vaseline)
7	1	Chlorinator O-ring (replacement)
8	1	Valve O-ring (replacement)
9	3	1" Hose Barb
10	3	1" Hose Clamp
11	1	Erosion Chlorinator Installation & Operation Manual
12	8	Tapcon Masonry Anchor Screw
13	1	Masonry Drill Bit

In addition to the items included with the Erosion Chlorinator kit, there are other tools and materials that will be required for assembly and installation. Table 4 shows all the required items that should be procured before going into the field to install the Erosion Chlorinator.



NOTE: This list only includes items required for assembly of the actual chlorinator as outlined in this manual. It does not include items for the rest of the water system (e.g. pump, supply line, fittings, water storage). Refer to the project design for these items.

Table 4 - Required Items in Addition to the Erosion Chlorinator Kit

	Description
1	Chlorine tablets and gloves
2	Nut driver (5/16”) or standard screwdriver
3	Power tools for mounting board

4. Installation

4.1 Installation Recommendations

The chlorinator should be installed into the piping line between the water source and storage tank as shown in Figure 6. The chlorinator is designed to operate at pressures up to 85 m (120 PSI) for Model EC 75-85 AV1 and up to 105 m (150 PSI) for Model EC 75-105a. Installing the chlorinator close to the storage tank will lower the operating pressure and increase the life expectancy of the components.

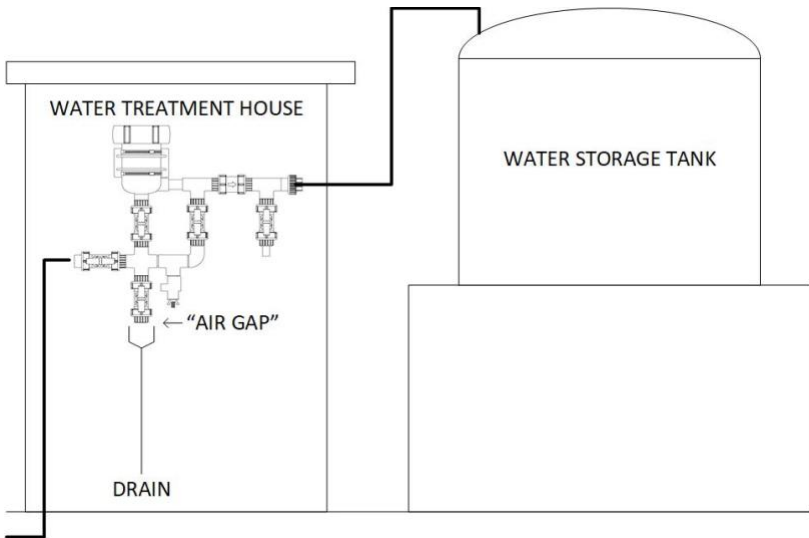


Figure 6 - Installation Diagram (typical) for Model EC 75-85 AV1



NOTE: The “air gap” between the chlorinator and drain pipe promotes complete drainage of the chlorinator housing.

Complete drainage is necessary for extended life of the components in contact with high concentrations of chlorine.



WARNING: The enclosure should be well ventilated to reduce the concentration of chlorine fumes released when adding or replacing chlorine tablets or draining the chlorinator.

To further increase the life expectancy of the chlorinator, it should be installed in a location that is protected against direct sunlight, weather conditions, and human tampering.

4.2 Installing the Erosion Chlorinator

Step 1: Mount the chlorinator.

The chlorinator and board need to be mounted vertically on a wall. Hold the board up against the wall in its desired location. Ensure that the board is level. Use the masonry drill bit to pre-drill holes into the masonry wall using the pre-drilled holes in the board as a template. These holes should be drilled $\frac{1}{4}$ " deeper than the length of the Tapcon screws. Screw the Tapcon screws through the board and into the masonry wall. These screws are designed for brick, concrete, or wood walls. It is recommended to use all eight Tapcon screws. Lastly, ensure that all nuts mounting the chlorinator to the board are tight. As mentioned previously, it is recommended that the chlorinator be mounted within a well-vented enclosure that is protected from direct sunlight, weather conditions, and human tampering.

Step 2: Connect the chlorinator to system piping.

The inlet and outlet connections are socket (female) 1" PVC. The chlorinator can be piped directly into the water system if the system has a flow rate of 12-75 LPM (3-20 GPM). For systems with flow rates above 75 LPM (20 GPM), multiple Erosion Chlorinators can be installed in parallel or the chlorinator can be installed with an external bypass. The kit comes with acetone wipes (primer) and PVC cement (shown in Figure 7) to connect the chlorinator to the water system.



Figure 7 - Acetone Wipes (Primer) and PVC Cement

Prime the areas to be glued by wiping them with the provided acetone wipes. Then use the provided PVC cement to either glue directly to the pipeline (Figure 8) or to glue in the provided 1" hose barbs if connecting to hose (Figure 9).



NOTE: The PVC cement is only compatible with PVC and CPVC. Other piping materials, such as HDPE, will require an additional adapter.



Figure 8 - Erosion Chlorinator Installation with Pipe Connection



Figure 9 - Erosion Chlorinator Installation with Hose Connection

4.3 Adding Chlorine Tablets

The chlorinator is designed to operate with any three-inch diameter chlorine tablets. As mentioned previously, Water Mission uses ACL 90 trichlor tablets from OxyChem (see Appendix B).

Step 1: Remove the chlorinator cover.

Remove the cover by unscrewing the collar and removing the lid as shown in Figure 10.



WARNING: Removing the cover may release concentrated chlorine fumes and should be done in a well-ventilated area. Make sure the chlorinator has been drained (Section 4.4) and that the drain valve (V-3) is open to ensure there is no pressure.



Figure 10 - Remove the Chlorinator Cover

Step 2: Add chlorine tablets.

Insert up to five chlorine tablets as illustrated in Figure 11.



WARNING: Concentrated chlorine fumes may be released when opening the chlorine bucket and should not be inhaled. Wear protective gloves to prevent contact with the tablets.



Figure 11 - Add Chlorine Tablets

Step 3: Grease the O-ring.

Remove the O-ring and wipe the O-ring groove to make sure there is no dirt or grit. Set the O-ring back in the groove. With clean fingers, pack the void space in the groove with Vaseline (or silicone, if available) as shown in Figure 12. This helps hold the O-ring in place and ensure a proper seal of the lid.



Figure 12 - Grease the O-ring

Step 4: Replace the cover.

Replace the lid and screw the collar back on as shown in Figure 13. Make sure that the O-ring is clean, sitting properly in the groove, and sealed with Vaseline before replacing the lid. Once the lid is in place, hand-tighten the collar $1/16^{\text{th}}$ to $1/8^{\text{th}}$ turn past tight.



NOTE: Do not use tools to tighten the collar (it may break if over-tightened).



Figure 13 - Replace the Cover

5. Operating Procedures

5.1 Start Up

After the chlorinator has been properly assembled and installed, use the following steps to start chlorinating water.

Step 1: Position the valves.

Close V-5 and V-3. Open V-1 completely and set V-4 to 50%. Set V-2 to 50% to start and adjust V-2 after testing free chlorine concentration.

Step 2: Start the flow of water.

Turn on the source pump to begin the flow of water to the chlorinator.

5.2 Testing and Adjusting the Chlorine Concentration

The chlorine concentration should be tested two minutes after start-up and multiple times throughout the day to ensure the water is safe for drinking. Water Mission recommends a free chlorine concentration of 0.2 to 0.5 mg/L **at the point of distribution**. Therefore, it is necessary to test the free chlorine at both the Sampling Valve (V-5) and the point of distribution. Depending on the distribution system, the free chlorine concentration may need to be higher than 0.5 mg/L at V-5 to achieve the correct range at the point(s) of distribution.



NOTE: If the containers being used by beneficiaries to collect safe water are not clean and cannot be washed, then a higher free chlorine concentration is recommended. In this situation, it is recommended that the free chlorine at the point(s) of distribution be 1 mg/L to ensure the safe water is protected from any additional contaminants that may be in the dirty water collection containers.

For detailed instructions on testing free chlorine concentrations, refer to the instructions included with the provided Hach Chlorine Test Kit.



NOTE: Make sure to use the “DPD Free Chlorine Reagent” when testing the free chlorine concentration.

Use the Chlorine Control Valve (V-2) to adjust the amount of chlorine. Make small adjustments at a time and wait one minute after each adjustment to retest the free chlorine concentration.

To increase the chlorine concentration: Rotate V-2 counterclockwise.

To decrease the chlorine concentration: Rotate V-2 clockwise.



NOTE: V-4 also affects the chlorine concentration, but is intended to be used for coarse adjustments, and V-2 is for fine adjustments. It is recommended to set V-4 halfway, but this can be adjusted for different ranges of chlorine concentrations. See Appendix A for more information on starting positions for V-2 and V-4. V-4 and V-2 should never be closed at the same time!

5.3 Shutdown and Draining the Chlorinator

When the chlorinator is not in use, it should be drained to prevent water from accumulating in the chlorine tablet housing. If water sits in the housing, it can become highly concentrated with chlorine and may damage the chlorinator or become dangerous for the operator.

Step 1: Turn off the source pump.

Step 2: Ensure that V-2 and V-4 are at least partially open.

Step 3: After water has stopped flowing through the system, open V-3 to drain water from the chlorinator.



WARNING: This should be done in a well-ventilated area as this water contains high chlorine concentrations. Chlorine fumes may also be released and should not be inhaled.



NOTE: Make sure air is displacing all the water in the chlorinator or it may not drain completely.

5.4 Replacing Chlorine Tablets

The chlorine tablets inside the chlorinator should be checked weekly or any time the chlorine concentration drops unexpectedly. There should always be at least half of a chlorine tablet in the chlorinator to provide consistent chlorine concentrations.

If less than half a tablet remains, first shut down the system and drain the chlorinator according to Section 5.3 *Shutdown and Draining the Chlorinator*. Then follow Section 4.3 *Adding Chlorine Tablets*. The new tablets can simply be added on top of the remaining half a tablet.

5.5 Maintaining and Resetting the Pressure Relief Valve

The pressure relief valve (PRV) should be flushed weekly. To flush PRV, first shutdown and drain the chlorinator according to Section 4.4, and then use the following steps.

Step 1: Turn the wing nut clockwise as shown in Figure 14 until it clicks.

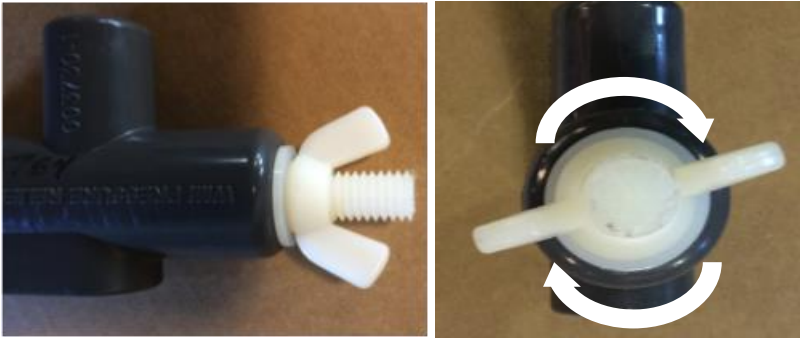


Figure 14 - Wing Nut on PRV

Step 2: Pull the wing nut and threaded rod out approximately one inch as shown in Figure 15 so that PRV is open on the bottom.



Figure 15 - Threaded Rod Pulled Out and Flush with Wing Nut

Step 3: Close V-2, V-3, V-4, and V-5. Open V-1. Turn on the source pump and flush PRV by allowing water to flow through it as shown in Figure 16 for about 5 seconds. Then turn the source pump off again.

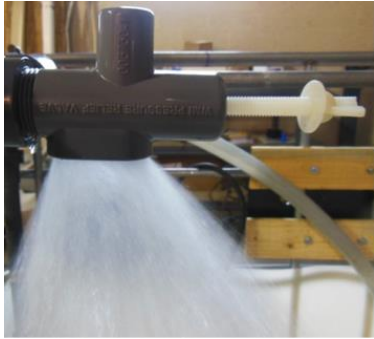


Figure 16 - Flushing PRV

Step 4: Turn the wing nut counterclockwise until the top of the wings are flush with the end of the threaded rod. Then reset PRV by firmly pushing the rod back into the normal operating position as shown in Figure 17 (a loud click will be heard).



Figure 17 - Resetting PRV

In addition to weekly flushing, PRV will need to be reset each time it opens. PRV will open if the operating pressure exceeds 4.5 Bar (45 m or 65 PSI) on Model EC 75-45 AV1 or 8.5 Bar (85 m or 120 PSI) on Model EC 75-85 AV1 to prevent damage. To reset PRV, turn off the source pump and reset the valve by pushing the threaded rod back into place as described in Step 4.

6. Troubleshooting

6.1 Fixing Leaks

If there is a leak in the system, first shutdown and drain the chlorinator according to Section 4.4. Then fix the leak by taking one of the following measures.

Leak at a glued joint: If the leak is at a joint that has been glued, replace the leaking PVC fitting at the joint.

Leak at a union fitting: Tighten the union fitting by turning it clockwise. If the leak persists, unscrew the slip fitting and check that the O-ring is still in place.

Leaking at the chlorinator: Tighten the collar by turning it clockwise. If the leak persists, remove the O-ring and inspect for damage. If the O-ring is damaged, replace with a new one. To reinstall the O-ring, first wipe the O-ring groove to make sure there is no dirt or grit and set the O-ring back in the groove. **With clean fingers, pack the void space in the groove with Vaseline (or silicone, if available). This helps hold the O-ring in place and ensure a proper seal of the lid.** Then, place the lid on top of the O-ring and screw the collar down until tight. Screwing the collar on ensures that the lid is pressing down on the O-ring evenly.

6.2 Varying Chlorine Concentrations

When the flow rate through the chlorinator varies, it may lead to fluctuations in the chlorine concentration at the sample valve (V-5). If this occurs, it is recommended to test the free chlorine concentration at the water storage tank or point of distribution instead. The water storage tank will equalize these variations and result in a more consistent chlorine concentration.

Appendix A: Chlorine Concentration Tables

The following tables present chlorine concentrations (in mg/L) based on various V-2 and V-4 positions for three flow conditions: 38, 57, and 76 LPM (10, 15, and 20 GPM). These values are based on laboratory tests and should only be used to inform starting valve positions. The valves should be set at startup based on the chlorine concentration one aims to achieve. Water chemistry, water temperature, and backpressure of the system will heavily influence the chlorine concentration for each project. The chlorine concentration should be adjusted based on sampling and testing described above in Section 5.2.

38 LPM (10 GPM)		V-2 Position (%)		
		30%	50%	70%
V-4 Position (%)	0%	1.9 mg/L	1.7 mg/L	1.7 mg/L
	25%	1.0 mg/L	1.1 mg/L	1.2 mg/L
	50%	0.6 mg/L	0.6 mg/L	0.8 mg/L
	75%	0.3 mg/L	0.5 mg/L	0.5 mg/L
	100%	0.3 mg/L	0.4 mg/L	0.3 mg/L

57 LPM (15 GPM)		V-2 Position (%)		
		30%	50%	70%
V-4 Position (%)	0%	1.6 mg/L	1.8 mg/L	2.0 mg/L
	25%	1.0 mg/L	1.1 mg/L	1.3 mg/L
	50%	0.5 mg/L	0.8 mg/L	1.0 mg/L
	75%	0.3 mg/L	0.4 mg/L	0.6 mg/L
	100%	0.2 mg/L	0.3 mg/L	0.4 mg/L

76 LPM (20 GPM)		V-2 Position (%)		
		30%	50%	70%
V-4 Position (%)	0%	1.3 mg/L	1.6 mg/L	1.6 mg/L
	25%	0.9 mg/L	1.1 mg/L	1.1 mg/L
	50%	0.5 mg/L	0.7 mg/L	0.8 mg/L
	75%	0.3 mg/L	0.4 mg/L	0.5 mg/L
	100%	0.2 mg/L	0.3 mg/L	0.3 mg/L

Appendix B: OxyChem ACL 90 Chlorine Tablets



SALES SPECIFICATION

ACL[®] 90 Disinfecting Tablets

This product is registered under FIFRA by the U.S. Environmental Protection Agency as a disinfectant for drinking water and wastewater systems (EPA Registration No. 935-40). Other tablet sizes are possible; contact Occidental Chemical Corporation for custom tablet and other packaging options.

<u>Property</u>	<u>Specification</u>
Chemical Composition	Trichloro-s-triazinetriene, CAS No. 87-90-1
Appearance	White tablets with smooth surfaces and well defined edges
Available Chlorine, wt. %	90 Minimum
Packaging	110.2 lb. / 50 kg. plastic drums 55 lb. / 25 kg. plastic pails
<u>Three-Inch Tablets</u>	
Diameter, inches	3.0 (76.2 mm)
Tablet Weight, grams	199 - 205
<u>Typical Properties</u>	<u>Value</u>
pH, @ 25°C (1% solution)	2.9 - 3.5
Bulk Density, lb/ft ³	63 - 66 (loose)
Water Solubility, g/100 g @ 25°C	0.98

Typical properties are listed for information only, and are not to be considered as specification requirements. These items are not analyzed on a routine basis. Product meeting the specification test items will exhibit the listed typical properties.

For further information, including the safety data sheet, visit:
<http://www.oxy.com/OurBusinesses/Chemicals/Products/Pages/ACL-and-Sodium-Chlorite.aspx>

