Operating manual

Chlorine 3000

Chlorine Analyzer

ba75696e02 07/2008

Accuracy when going to press

The use of advanced technology and the high quality standard of our instruments are the result of a continuous development. This may result in differences between this operating manual and your instrument. Also, we cannot guarantee that there are absolutely no errors in this manual. Therefore, we are sure you will understand that we cannot accept any legal claims resulting from the data, figures or descriptions.

Note
The latest version of the present operating manual can be found on the Internet under www.WTW.com.

Contents

1 Overview

The Chlorine 3000 online chlorine analyzer allows for the reading of chlorine levels of drinking water and process water on-line. The Chlorine 3000 has been designed to meet the design criteria specified by Standard Methods for the Examination of Water and Wastewater (21st Edition) Method 4500-Cl G, DPD Colorimetric Method. The Chlorine 3000 uses a 515 nm LED as the measurement light source. The chlorine analyzer can be used to measure Free Chlorine or Total Chlorine, depending on the reagent kit used (see chapter 12 REPLACEMENT PARTS AND ACCESSORIES).

1.1 Scope of delivery

Item	Quantity
Chlorine 3000 analyzer	1
Operating manual	1
Mounting set (4 fastening eyes, 4 screws and 1 ferrite)	1
Tubing/Cuvette kit (8 black "B“ tubes, 2 cap assemblies, 1 replacement cuvette	1
In-line strainer with length of tubing	1
Check valve flushing kit	1

Remove the instrument from the packing carton. Carefully inspect all items to ensure that no visible damage has occurred during shipment. If the items received do not match the order, please immediately contact the local distributor or the WTW customer service department.

1.2 The display

Fig. 1 illustrates all the items that can appear on the display. The upper row of the display (1) is used for reporting the chlorine levels and to provide user guidance in the customer setting routine. The lower row of the display (2) is used to communicate error messages (message queue) and provide user guidance. The display has two icons (3) that are used to indicate the use of access code and offset mode. In addition, mode arrows (4) are used to indicate the current instrument operating mode; AUTO (normal operation), CAL (calibration) and CONFIG (configuration).

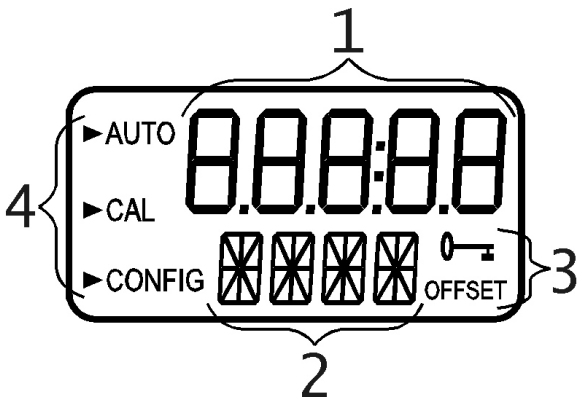


Fig. 1: Display used in the instrument.

(All items used on the display are shown in this figure.)

1.3 Touch pad

Figure 2 illustrates the touch pad. The touch pad has six buttons: **PRIME**, **SERVICE**, **MODE/EXIT, OK,** ▲ and ▼.

The **MODE/EXIT** button is used to cycle between the three operational modes of the instrument: **CAL, CONFIG,** and **AUTO** (measurement) mode. The **OK** button enters the option or mode that is highlighted or chosen. The ▲ and ▼ buttons are used to change settings.

The **PRIME** and **SERVICE** buttons are dedicated controls. The **PRIME** will start 75 reagent pump pulses to prime the tubing after a change or addition of reagent bottles. The **SERVICE** button will drain the instrument and hold all operations until either the **SERVICE** button is pushed again or the power is reset. This button should be used while changing the tubing, the measurement cuvette or reagent bottles (see chapter 10 MAINTENANCE).

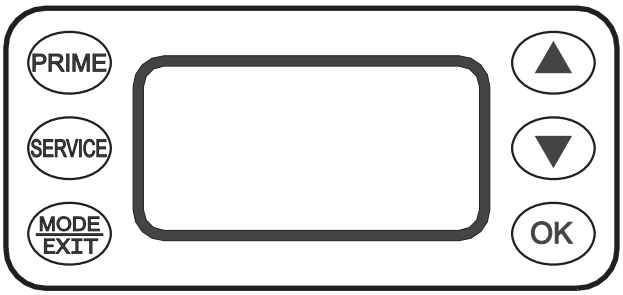


Fig. 2: The Chlorine 3000 touch pad.

2 Safety instructions

This operating manual contains basic instructions that you must follow during the commissioning, operation and maintenance of the instrument. Consequently, all responsible personnel must read this operating manual before working with the sampler.
The operating manual must always be available within the vicinity of the instrument.

Target group

The instrument was developed for use in online analysis. Thus, we assume that the operators are familiar with the necessary precautions to take when dealing with chemicals as a result of their professional training and experience.

General safety instructions

Safety instructions in this operating manual are indicated by the warning symbol (triangle) in the left column. The signal word (e.g. "Caution") indicates the danger level:

WARNING
indicates instructions that must be followed precisely in order to prevent serious dangers to personnel.

CAUTION
indicates instructions that must be followed precisely in order to avoid slight injuries to personnel or damage to the instrument or the environment.

WARNING
Improper handling of the chemicals may cause severe damage to your health (poisoning, corrosion). The solutions must only be prepared by persons who have been instructed on how to handle chemicals.
The safety datasheets of the chemicals used must be read carefully. The protective measures mentioned there must be followed. In any case, wear appropriate protective clothing such as protective goggles, gloves etc.
The safety datasheets of the chemicals used in the Chlorine 3000 are available on the Internet under www.WTW.com.

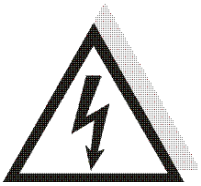
Other labels

Note
indicates notes or helpful hints that draw your attention to special features and give further clarification to the instructions. Refer to the *Table of Contents* to easily find specific topics and to learn about unfamiliar terms.

Authorized use

This instrument is authorized exclusively for online chlorine measurements in drinking water and process water.
The technical specifications as given in chapter TECHNICAL DATA, must be observed. Only the operation and running of the measuring instrument according to the instructions given in this operating manual is authorized. Any other use is considered to be **unauthorized**.

Installation



Danger

Only qualified electricians should be allowed to perform the installation of the instrument as it involves a line voltage that could endanger life.

Function and operating safety

This instrument left the factory in a safe and secure technical condition. The smooth functioning and operational safety of the instrument can only be guaranteed if the generally applicable safety measures and the specific safety instructions in this operating manual are followed during operation.

The smooth functioning and operational safety of the instrument can only be guaranteed under the climatic conditions specified in the chapter TECHNICAL DATA.

Safe operation

If safe operation is no longer possible, the instrument must be taken out of service and secured against inadvertent operation!
Safe operation is no longer possible if the instrument

- has been damaged in transport
- has been stored under adverse conditions for a lengthy period of time
- is visibly damaged
- no longer operates as described in this manual.

If you are in any doubt, please contact the supplier of the instrument.

Obligations of the operator

The purchaser of this instrument must ensure that the following laws and guidelines are observed when using dangerous substances:

- EEC directives for protective labor legislation
- National protective labor legislation
- Safety regulations
- Safety datasheets of the chemical manufacturers.

3 Theory of operation

The Chlorine 3000 has two solenoid valves, one for sample water (FLOW) and one for draining of the cuvette (PURGE). A third solenoid, along with four check valves forms a reagent pump. Sample water flow is controlled by the FLOW solenoid valve. The PURGE solenoid valve is used to empty the measurement cuvette.

The measurement chamber consists of a sample inlet, a purge drain, and an overflow. The reagent is added below the cuvette. A green LED provides the 515 nm source lamp, a red LED is used for sample level and flow measurement. A single detector is located opposite (180 º from) the green LED. A replaceable glass cuvette separates the sample water from the optical devices and maintains the measurement path length. Sample water flows in the inlet at the bottom, through the measurement cuvette and out through overflow drain. This flow is used to both fill the cuvette and flush the system.

The chlorine analyzer can be used to measure Free Chlorine or Total Chlorine, depending on the reagent kit used (see chapter 12 REPLACEMENT PARTS AND ACCESSORIES).
The reagents consist of two replaceable bottles. One bottle has a buffer to control the pH; the second has an indicator that contains the DPD, which produces color when chlorine is present in the sample. The degree of color is dependent on the amount of chlorine in the sample water.

The measurement chamber is open to view operations in the cuvette. A white LED backlights the chamber for a clearer view. The white LED will flash to attract attention in the case of a warning or failure. Most warnings and failures are displayed on the screen.

During normal operation the Chlorine 3000 will run through a timed cycle. A simplified cycle will consist of the following sequences:

- Flushing – continuous sample flow
- Zeroing – no flow with cuvette full
- Purging – PURGE valve opens
- Adding reagents – one pulse of the reagent pump
- Mixing with sample – sample flow pulses in
- Reading resulting sample – no flow with cuvette full
- Purging – PURGE valve opens to remove reacted sample

The cycle above does not describe all the actions and testing that occurs. The CPU continuously diagnoses the entire system for correct operation and sample water flow. If an error occurs, a message is posted to the message queue.

The reagent is added from the front, below the cuvette, by a single pulse of the reagent solenoid. When the reagents require replacement, the **PRIME** button is pushed to bring new reagents into the system. The reagent solenoid is pulsed several times to draw fluid from the two reagent bottles and fill the tubes with new reagent. A complete purge takes less than a minute.

The **SERVICE** button empties the cuvette, stops the flow of sample water, and clears any errors. This provides a convenient way to replace reagents and the measurement cuvette. If more extensive servicing is performed, all power to the Chlorine 3000 should be removed.

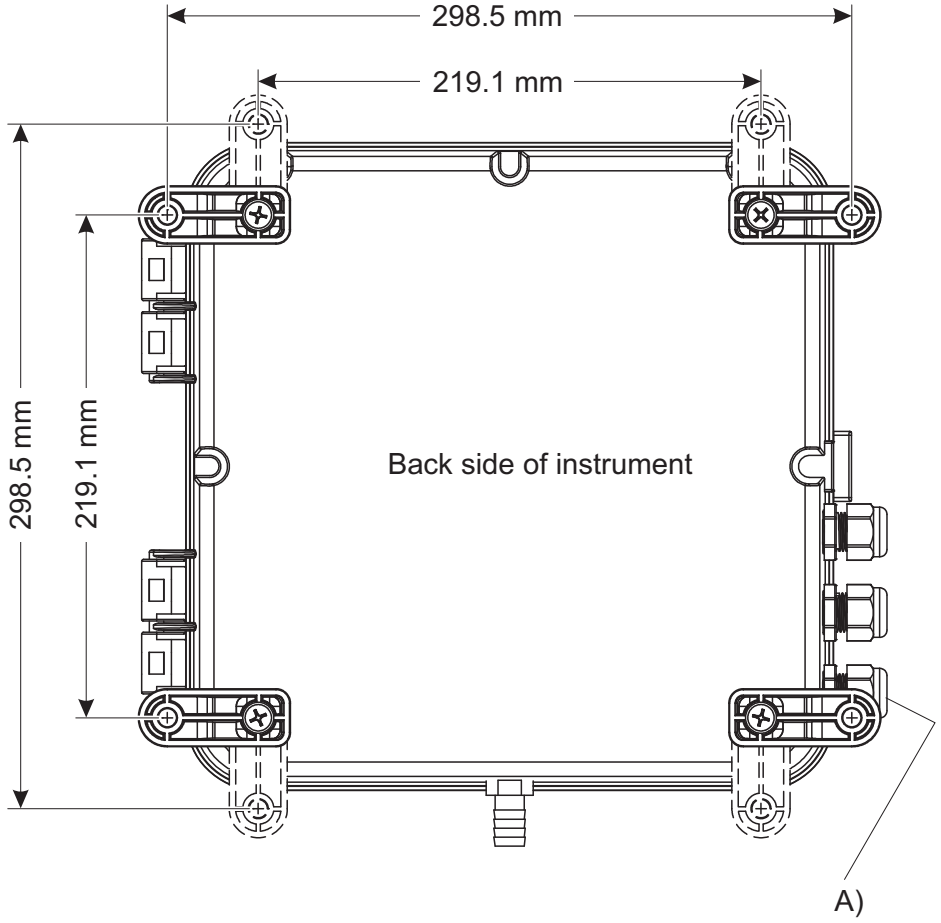
CAUTION
If the Chlorine 3000 is to be turned off, it is recommended that the instrument be placed in SERVICE mode before removing power. This ensures that the cuvette is emptied and the flow is off (see chapter 10).

4 Installation and commissioning

Prior to use for the first time, the reagents will have to be prepared (see section 4.4 PREPARING THE REAGENTS).

4.1 Mounting and site selection

The analyzer was designed for wall mounting in an upright position. Choose a location that is easily accessible for operation and service and ensure that the front display rests at eye level. Consideration must be made for the plumbing connections. The overall mounting dimensions of the instrument are shown in Fig. 3.



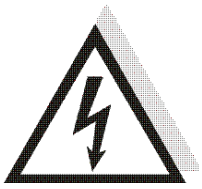
A) If the fastening eye should be mounted in this position, remove the nut for mounting and screw it on again afterwards.

Fig. 3: Overall mounting dimensions of the instrument

It is critical that the instrument be mounted as close as possible to the sampling point to ensure a quick response time (within 2-3 meters (6-10 ft) of the sampling point).

The supplied fastening eyes have to be mounted on the Chlorine 3000 with the supplied screws. These can be rotated as shown above. Suggested mounting screws are up to M6 (1/4 ").

4.2 Electrical connections



WARNING

- **Only qualified electricians should be allowed to perform the installation of the instrument as it involves a line voltage that could endanger life.**
- **The electrician must have read and understood this manual and must follow the instructions in this manual.**
- **Before starting any installation work make sure all cables are voltage free.**
- **The instrument is equipped with a 100 … 240 VAC, 47 … 63 Hz switching power supply requiring 150 VA. Before connecting the instrument check whether the line power meets this specification.**
- **Install a circuit breaker prior to the power connection to allow for service.**

All of the electrical connections to the instrument are made at the termination area which is located on the left side of the instrument. Remove the high voltage cover by loosening the captive screw, see Fig. 4. The connections are labeled within the terminal box and are self-descriptive. Please follow all local and government recommendations and methods for installation of electrical connections to and between the instrument and other peripheral devices.

Plugs are inserted into the communication bulkhead (9) and alarm bulkhead (6) when shipped, to ensure a watertight seal. These plugs should be removed and discarded when cabling to either of these connections.

The power bulkhead (4) will accept cable diameters from 5.8 mm (0.230 in.) up to 10 mm (0.395 in.). All terminals are designed to accept wires in the range of 14 … 28 AWG. All wires should be stripped to a length of 6 mm (¼"). A strain relief strap is provided to reduce tension on the power terminals.
It is the user's responsibility to assure that a watertight seal is maintained after the Chlorine 3000 has been wired for operation.

WARNING

If any of the bulkheads are not tightened properly around a cable or plug, there is a possibility of creating a shock hazard and the ratings of the instrument will be jeopardized.

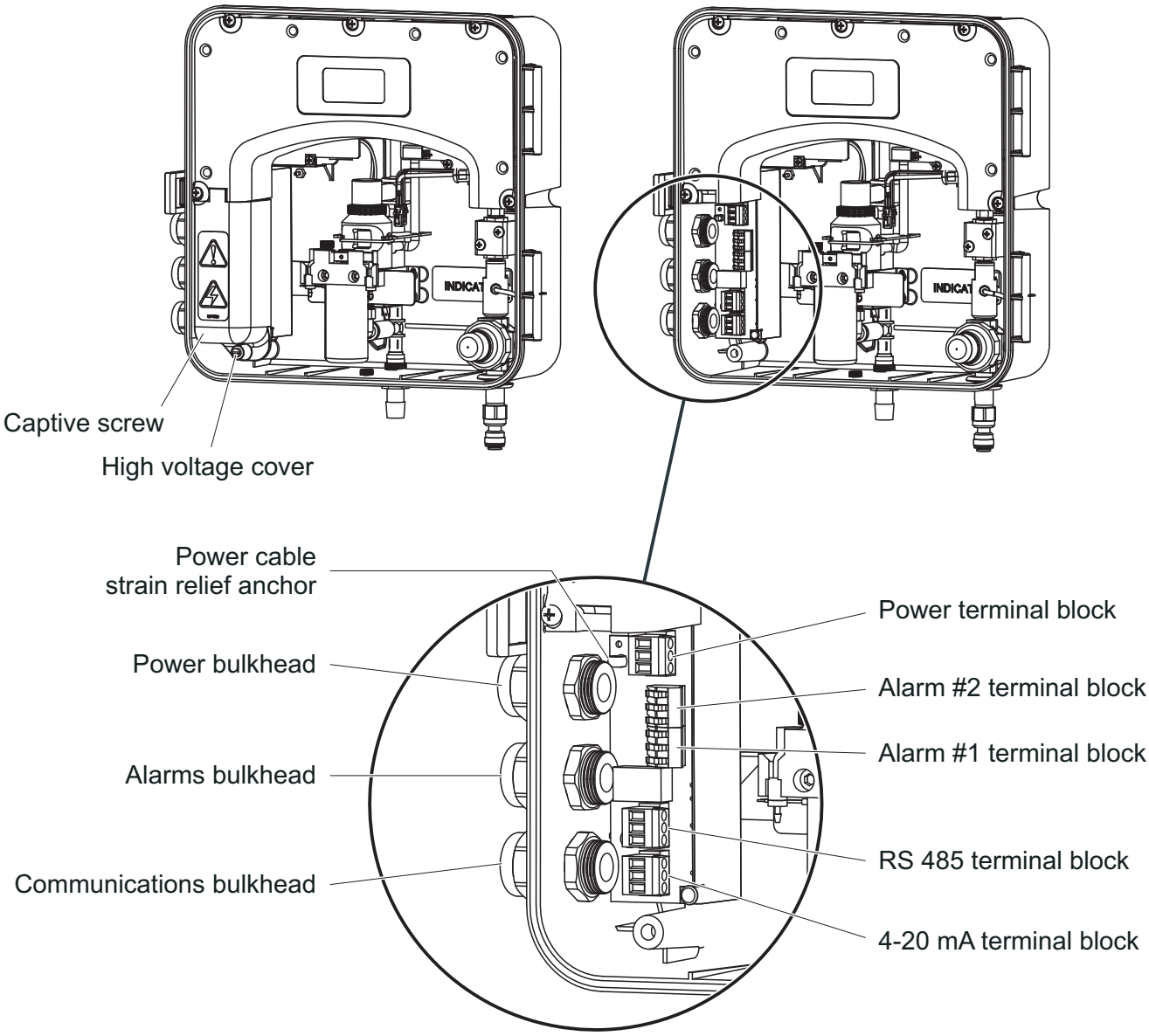


Fig. 4: Electrical connections for the instrument 2

4.2.1 Power

Follow the safety instructions at the beginning of this section. For safety reasons, keep the length of the power cable under 2 m (6 ft.). While making connections, refer to Fig. 4.

The Chlorine 3000 is intended for cord connection with a three wire non-locking grounded power cord. The Chlorine 3000 is not supplied with a power cord. If the Chlorine 3000 is to be used in the U.S. or Canada the power cord must be UL Listed & CSA Certified. Please consult all local electrical codes for proper connection.

The connection block is marked as follows: N for Neutral, L for line, the third symbol indicates a secure earth ground. The green removable terminal block is suitable for wire gauges 18 to 12 AWG.

The green terminal block can be removed for easier connection of the power cable. The power cable should be guided through the cable tie at the strain relief anchor before being connected. Then reconnect the terminal block and pull tight the cable clip.

4.2.2 RS 485

The RS 485 half-duplex (2-wire) digital interface operates with differential levels that are not susceptible to electrical interferences. This is why cable length up to 1000 m (3000 ft) can be implemented. The last device on each bus may require terminating with a 120 ohm resistor to eliminate signal reflection on the line. Do not run RS 485 cables in the same conduit as power. Setup of the RS 485 is covered in section 7.3 CONFIGURING THE RS 485 PORT. To prevent damage to the instrument, ensure that power is disconnected prior to making connections. For ease of connecting, remove the RS 485 terminal block (see Fig. 4). Connections are labeled beside this termination on the PC board.

The recommended cable is 22 AWG shielded twisted pair. The grey terminal block is removable to assist in making connections.

4.2.3 Relays

The Alarm 1 and Alarm 2 relays are mechanical relays rated at 240 VAC 2A. Please note that the relays are labeled NO (Normally Open), NC (Normally Closed) and C (Common). As these alarms are configured fail-safe, the normal condition is with power applied to the Chlorine 3000 and in a non-alarm condition. Operation of these alarms is covered in section 7.4 CONFIGURING THE ALARMS.

The lever operated terminal blocks are rated for wire gauges AWG 28-14.

4.2.4 4-20 mA

The 4-20 mA output is driven by a 15 VDC power source and can drive recorder loads up to 600 ohms. Transformer isolation is provided on the Chlorine 3000. Do not run 4-20 mA cables in the same conduit as power. Operation of this output is covered in section 7.1 SETTING THE 4-20 MA OUTPUT.

To prevent damage to the instrument, and for general safety ensure that power is disconnected to the Chlorine 3000 prior to making any connections. For ease of connecting, remove the 4-20 mA terminal block. Polarities of the connections are labeled beside this termination on the PC board.

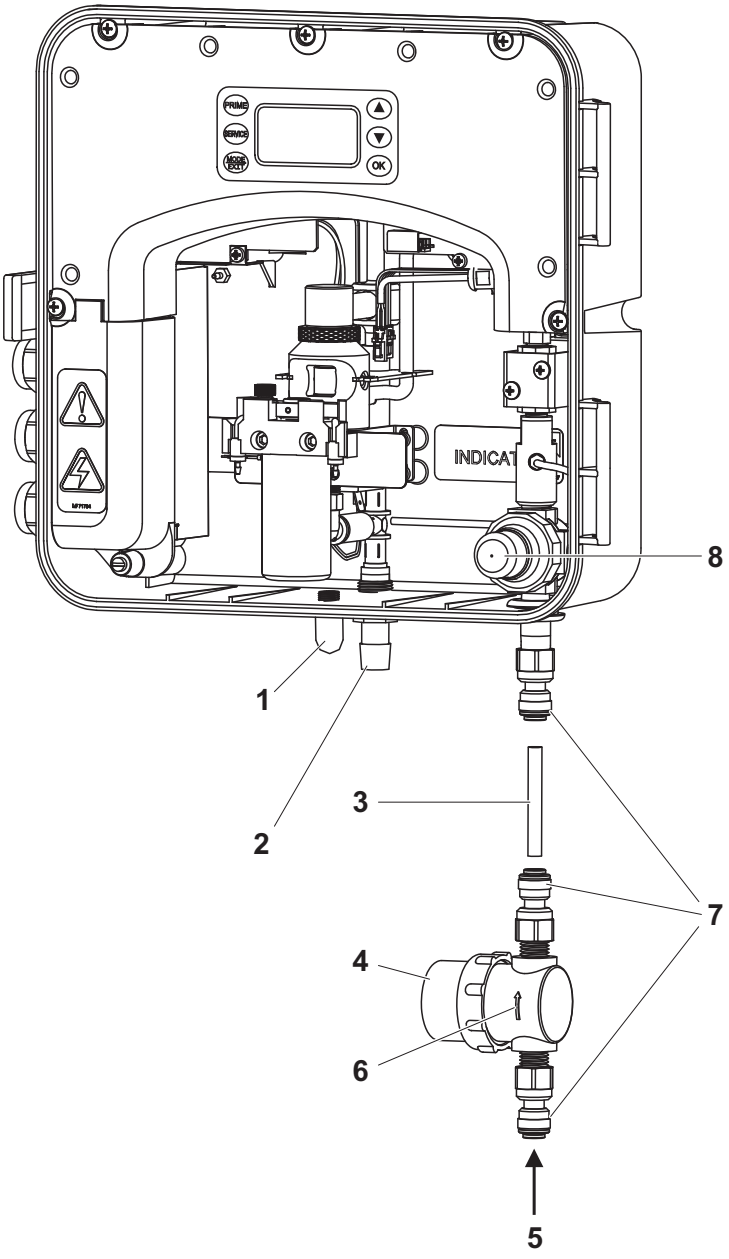
The recommended cable is 22 AWG shielded twisted pair. To prevent ground loops, connect the shield at **either** the Chlorine 3000 or at its destination, but not both. The grey terminal block is removable to assist in making connections.

4.2.5 RS 485/4-20 mA cable ferrite

To meet IEC requirements for RF radiated immunity a clamp-on type ferrite is supplied. It should be placed on the RS 485 or 4-20 mA cable outside, but as close as possible to the Chlorine 3000. If both outputs will be used, an additional ferrite will be needed. It can be ordered from WTW.

4.3 Plumbing

Figure 5 demonstrates the recommended plumbing for the instrument. The instrument is designed to require very little head pressure to operate, but will need around 0.34 bar (5 PSI). The integral pressure regulator is rated for a maximum pressure of 10.3 bar (150 PSI). The maximum allowable fluid temperature is 40°C (104°F).



1	Cabinet vent
2	Drain connection (for tubing with 12.7 mm ID)
3	Piece of tubing with 6.35 mm OD (supplied)
4	In-line strainer with quick connect fitting (included in the scope of delivery)
5	Sample inlet
6	This arrow on the in-line strainer must be pointed towards the Chlorine 3000
7	Quick connect fitting (preassembled)
8	Pressure regulator

Fig. 5: Recommended plumbing for the instrument

The supplied in-line strainer (4) is installed in front of the 6.35 mm inlet to prevent the clogging of the instrument. If a pipe fitting change is required, this adaptation should be made at the in-line strainer (6), not at the instrument. It has quick connect fittings (7). Opaque tubing should be used if the tubing will be exposed to sunlight, to prevent algae growth. Please note that the supplied connectors are compatible with 6.35 mm OD (1/4") semi rigid or rigid tubing.

The instrument is equipped with an internal cabinet drain (vent) to prevent damage in the event of a tubing failure (2).

The outlet tubing (tube size 12.7 mm or 1/2" ID) is connected to the outlet connection (2). It is recommended that opaque tubing be used to prevent algae growth. Keep this tubing as short as possible. The outlet must be pressure free and back pressure free and must be kept open to atmosphere.

CAUTION

The fluid waste from drain connection of this instrument contains reagents diluted with large quantities of sample water. We recommend that operators check with local authorities concerning proper disposal of waste fluids.
A 12.7 mm ID (1/2") tubing can be placed over the cabinet vent to redirect accidentally leaked liquid into a suitable container.

4.4 Preparing the reagents

Reagent kits are available from WTW for Free Chlorine and for Total Chlorine (see chapter 12 REPLACEMENT PARTS AND ACCESSORIES). There are two reagents required and supplied in each kit, the **buffer** and the **indicator**.

Materials required
The buffer solution and the indicator solution have to be prepared (about 30 min). The following is required for this:

For the buffer solution:	For the indicator solution:
Buffer bottle with salt (included in reagent kit)	Indicator bottle with salt (included in reagent kit)
Deionized water (approx. 500 mL)	Deionized water (approx. 500 mL)
	DPD powder bottle (included in reagent kit)

WARNING
Improper handling of the chemicals may cause severe damage to your health (poisoning, corrosion). The solutions must only be prepared by persons who have been instructed on how to handle chemicals.
The safety datasheets of the used chemicals (to be found on the Internet under www.WTW.com) have to be read carefully. The protective measures mentioned there must be followed. In any case, wear appropriate protective clothing such as protective goggles, gloves etc.

Preparing the buffer solution for free chlorine or Total chlorine (depending on reagent kit):
- Add approx. 400 mL deionized water into the buffer bottle.
- Cap tightly and shake the bottle vigorously to dissolve the salt (this may take 15 – 30 minutes)
- When fully dissolved add deionized water to bring the volume of the buffer solution up to the fill line. Shake again.

Preparing the indicator solution:
- Add approx. 400 mL deionized water into the indicator bottle.
- Cap tightly and shake vigorously until the powder is dissolved.
- Add the contents of the DPD powder bottle (small brown bottle) to the indicator bottle.
- Cap tightly and shake the indicator bottle to dissolve the solid.
- When fully dissolved add deionized water to bring the volume of the indicator solution up to the fill line. Shake again.

CAUTION
Please note that life of the mixed indicator solution is only 1 month. Note down the mixing date on the label of the bottle. Old solutions must be disposed of properly.

4.5 Connecting the reagents

In the delivery condition of the Chlorine 3000, the tubes required for operation, reagent bottle caps and cuvette are already installed in the instrument.
Carefully put the reagent bottles prepared according to the instructions into the instrument, without the bottle caps. When doing so follow the labeling for the positioning of the bottles (buffer left, indicator right). Put the reagent bottle caps on the bottles (intake tubes in the bottles) and screw them on (reagent exchange, see Fig. 7 in chapter 10 MAINTENANCE).

Checking for *leakproofness*
Press the **SERVICE** button to start sample flow to the system. Check for leaks. If a leak occurs press **SERVICE** again to empty the system, repair leak and try again.

Note
The tubes may darken due to contact with the reagent. This does not affect their operability.

4.6 Adjusting the flow rate

The flow rate on the Chlorine 3000 was factory adjusted and should not need adjustment. Installation variances may affect the flow. The optimal flow rate through the Chlorine 3000 may be adjusted if needed. The flow is adjusted by turning the adjustment screw on the pressure regulator. (see Fig. 5). To assist in this adjustment, proceed as follows:

1. Press the **SERVICE** button.
2. Wait for the display to read HOLd, then press **Mode/ Exit**.
3. The display will show FLOW and the number 0. Press either ▲ or ▼.
4. Chlorine 3000 will drain, and then pulse in water while a count is displayed on the screen.
5. The display will show one of three messages HI, LO or Good.

The flow test determines if the flow rate is suitable for proper operation. Loosen the locking nut then adjust the pressure regulator using a coin or a large flat blade screwdriver. Press either the ▲ or ▼ button while in the FLOW routine to display a new flow rate. Please note that only ¼ turn incremental adjustments should be made to the regulator on each attempt.
If the message is LO, turn the regulator control clockwise. If the message is HI, turn the regulator counterclockwise. If the message is Good, no adjustment is required. Tighten the locking nut after adjustment. To return to normal operation, press the **OK** button.

Then carry out the 5 steps described above once again (several times if necessary), until the message during step 5 is Good, i.e. the flow rate is suitable.

When the suitable flow rate is displayed, fix the adjusted flow by tightening the hexagon nut using an open-ended wrench.

To return to normal operation, press the **OK** button.

5 Operation

The Chlorine 3000 online chlorine analyzer allows for the reading of chlorine levels of drinking water and process water on-line. The chlorine value of the process water is usually reported in milligrams per Liter (mg/L), these units are equivalent to Parts Per Million (PPM).

Readings above 10.00 mg/L are outside the range of this instrument. Although the Chlorine 3000 may display above 10.0 mg/L, these readings will not be within the stated accuracy. As the reagents degrade due to aging, readings above 10.0 mg/L may decrease in value.

5.1 Routine measurement

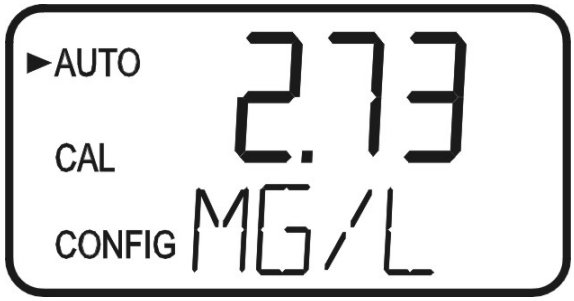
First, ensure that all plumbing and electrical connections are complete before continuing.

The following steps describe how to measure the value of chlorine of a sample using this instrument:

1. Apply power to the instrument and allow the unit to warm up (typically 45 minutes to one hour on initial commissioning).
2. When a continuous process stream is flowing through the instrument, press the **PRIME** key**.**

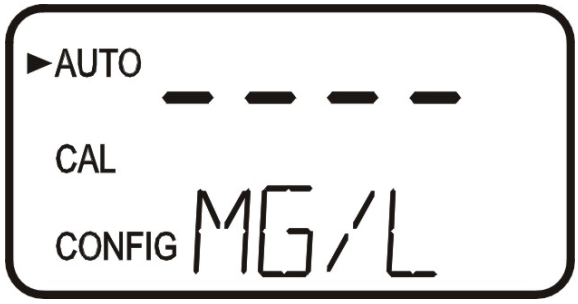
The instrument will display the measured chlorine level of the sample by displaying it on the LCD screen. In addition, the equivalent signal is provided on the analog (4-20 mA) output, or the digital output (RS 485), depending on the options selected.

During normal operation, the instrument will have the arrow beside AUTO highlighted. The current scale is displayed on the lower row of the display and the measured reading on the upper row of the display (see illustration below).



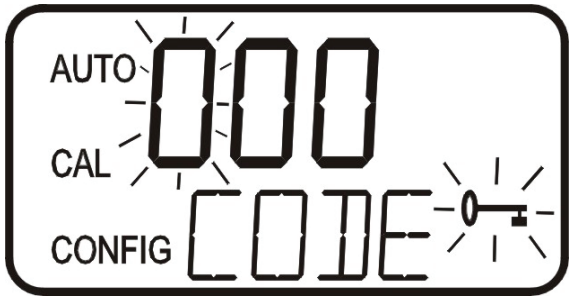
The screen depicted below indicates that the system has just been started or just entered AUTO mode from Service mode and no readings have been taken yet.

Note
Please note that calibrations will not be allowed until a reading is posted.



5.2 Security access feature

The instrument is equipped with a security access code feature that can be activated in the configuration mode. If the security feature is enabled, the screen shown in the illustration below will appear when the **MODE/EXIT** button is pressed.



The security code (333) must be entered to gain access to **CAL** or **CONFIG** menus. Notice that the first number in the code is flashing. The flashing indicates that this is the number to be changed. Use the ▲ or ▼ arrows to select the first of the three numbers in the code and then press the **OK** button to accept the first number of the code. Now enter the second number in the code. Proceed as with the first number followed by **OK**. Then repeat the process for the third number in the access code, and finish with the **OK** button.

If the valid access code has been selected, the instrument will be directed to the calibration mode. If the wrong access code is selected, the instrument will return to the **AUTO** mode. Refer to section 7.5 ENABLING THE SECURITY ACCESS for more information.

5.3 White LED

A white LED is used to illuminate the measurement cuvette for easy viewing of the instrument operations. During the Zeroing portion of the cycle and the Measurement portion of the cycle, when the green LED is active, the white LED is turned off to lower interference. This is normal operation for the instrument and does not represent an error or problem.

The white LED is also used to draw attention to a problem as described in section 9.1 TROUBLE SHOOTING. In these instances the white LED blinks at a constant rate dependant on the severity of the problem, but is still turned off as described above. Please note that any fault is always posted to message queue on the lower portion of the LCD.

6 Instrument calibration

The instrument was tested prior to leaving the factory. Since it operates from a predetermined calibration curve, no calibration is required.

The Chlorine 3000 is factory-calibrated. **The Instrument does not require calibration if not otherwise stipulated by authorities for compatibility purpose.**

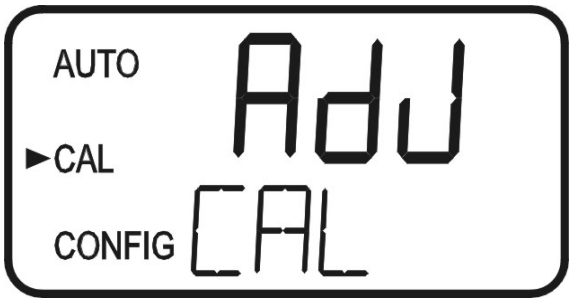
Calibration can easily be performed if required. The method is by comparison against another instrument, such as a laboratory or hand held photometer (such as WTW's photoLab or pHotoFlex, see WTW catalog or on the Internet under www.WTW.com).

There are two points of calibration. The slope or gain and the zero (offset). To perform the zero the instrument must be plumbed to a sample of known chlorine free water such as deionized water for a zero adjustment.

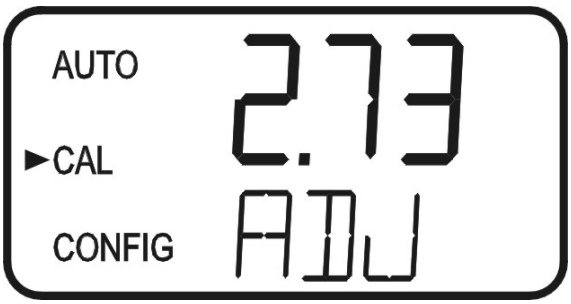
6.1 Slope (gain) calibration procedure

It is important that the chlorine level be quite stable to use this method. The comparison will be made against a trusted measurement such as a chlorine photometer, spectrophotometer, or an amperometric titration.

1. Obtain a grab sample of the flow.
2. Measure the value of the sample with one of the methods shown above.
3. On the Chlorine 3000, press the **MODE/EXIT** button once. The screen is shown below.



4. Press **OK** to enter the calibration adjustment.



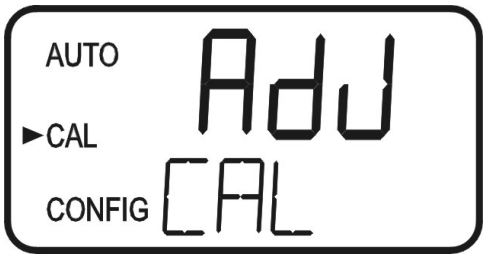
5. The screen will show the current reading on the Chlorine 3000. Using the ▲ or ▼ buttons adjust the reading to agree with the laboratory method or portable photometer.
6. Press **OK** to accept the calibration adjustment and return to AUTO measurement mode.

Note
There is a limit to the size of the change that can be made to a current reading. The upper limit is the current reading times 1.5. The lower limit is the current reading divided by 1.5. Ensure a reading is posted to the display before calibrating. Otherwise, a nOnE error will be displayed.

6.2 Zero (Offset) calibration procedure

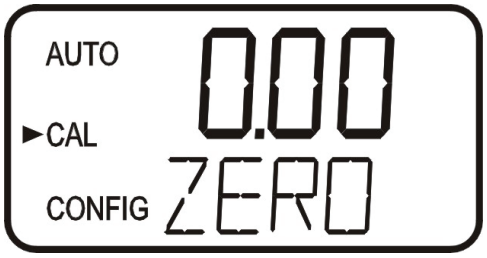
Generally this calibration is only required if readings are expected to be below 1 mg/L or if it is required by a regulatory authority. To perform this calibration, the water supply to the Chlorine 3000 must be changed to known chlorine free water such as deionized water. This chlorine free water must be run through the instrument for at least 5 minutes prior to using the following procedure.

1. On the Chlorine 3000, press the **MODE/EXIT** button once. The screen is shown below.



2. Press either the ▲ or ▼ buttons to get the following screen.

3. Press **OK** to enter the zero calibration screen.



4. The screen will show the current reading on the Chlorine 3000. Since there is no chlorine, this is a zero offset. Since there is no chlorine, the only reading may be a slight offset due to the absorbance of the reagents. There should be no pink color developed.
5. Press **OK** to perform a Zero calibration. When the calibration has completed the instrument will return to AUTO measurement mode automatically.

Note
There is a limit of ±0.20 mg/L total adjustment available. A ZERO calibration greater than this will cause a CAL warning and no calibration will have occurred. Enter SERVICE mode to clear this error.

6.3 Restore factory settings

If the Chlorine 3000 displays a CAL error or the calibration was incorrectly performed, it may be desired to restore the factory calibration. All factory defaults including factory configurations can be reset by holding down the ▲ button and then pressing and releasing the **OK** button then releasing the ▲ button.

7 Instrument configuration (CONFIG mode)

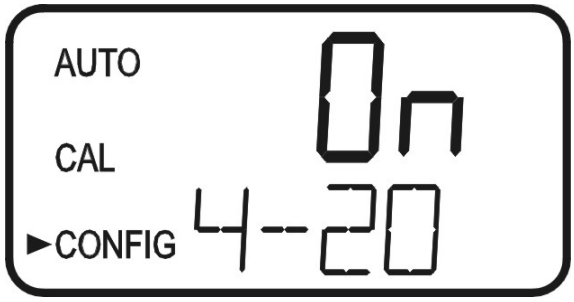
The instrument has been designed to provide the ability to customize the instrument according to needs at any time during normal operation. This mode has been split into submenus to facilitate instrument configuration. This section describes how to use each of the submenus to configure the instrument. While in the configuration mode, the instrument has a time-out feature that automatically returns the system operation to the **AUTO** mode after a fifteen (15) minute period of no button pushes.

Select the CONFIG mode by pressing the **MODE/EXIT** button until the arrow beside CONFIG is illuminated on the display. Then press the **OK** button.

Note
To exit the **CONFIG** mode, press the **MODE/EXIT** button.

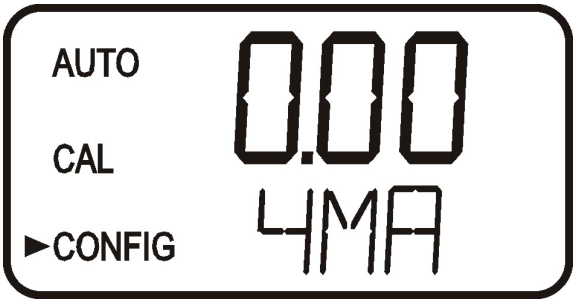
7.1 Setting the 4-20 mA output

The first configuration selection is **4-20** for the 4-20 mA output. Select the either **On** or **OFF** using the ▲ or ▼ buttons. Once the desired output has been set, press the **OK** button to accept it. The next prompts will depend on the output selected.



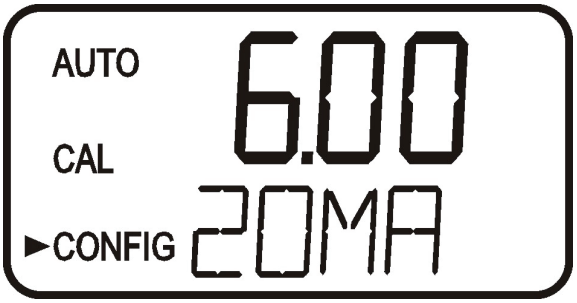
If the 4-20 mA output was turned **On**, prompts to set the 4mA **(4MA)** and 20mA **(20MA)** chlorine limits will be displayed. There will also be a menu to adjust the error level (ERLV). The first prompt will be the chlorine limit assigned to the 4 mA output level:

Select the chlorine level to assign to the **4mA** using the ▲ or ▼ buttons.



Once the desired level has been set, press the **OK** button to accept it.

The next prompt will be the chlorine level assigned to the 20mA. Select the chlorine level using the ▲ or ▼ buttons. Once the desired level has been set, press the **OK** button to accept it.



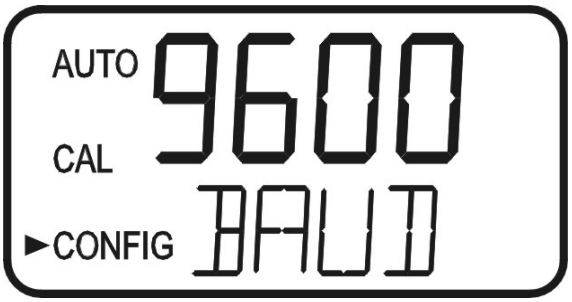
7.2 Configuring the error level

In case of an error in the Chlorine 3000, the 4-20 mA reading can be used to indicate a problem by sending the current to either 4.00 mA, 2.00 mA or 0.00 mA. The factory default setting is OFF. Select the desired ERLV by using the ▲ or ▼ buttons then press the **OK** button to accept the level.

7.3 Configuring the RS 485 port

The instrument is equipped with an RS 485 port which operates in Simple bus or Modbus. Prompts will appear for setting the baud rate, the address and the Modbus transmission mode (RTU or ASCII).

Select the correct baud rate (1200, 2400, 4800, 9600, or 19200) for operation of the I/O port by pressing the ▲ or ▼ buttons to change the displayed baud rate.



Press the **OK** button to continue on and select the desired instrument address using the ▲ or ▼ buttons. Once the selection is satisfactory, press the **OK** button.

To use the Modbus mode, select ASCII or RTU. Information on the Modbus is given in a separate operating manual (available on the Internet under www.WTW.com).

7.4 Configuring the alarms

Two relays are provided that are designed to operate as two independent programmable alarms or as a system problem alarm. Please note that changes to alarms will not be recognized until the start of the next cycle. Two settings must be selected to fully program each alarm:

1. The alarm function (HI, LO, OFF or Error)
2. The alarm set point (level at which the alarm activates)

These items are described below:

Alarm function:
The alarms can either be turned OFF or selected to operate in one of three different manners:

1. HI alarm: the relay changes state when the measured chlorine level is higher than the programmed alarm level (set point).
2. LO alarm: the relay changes state when the measured chlorine level is lower than the programmed alarm level (set point).
3. Error alarm: If there is a system fault or problem the alarm will change states.

Alarm set point:
The chlorine level at which an alarm activates is called the alarm set point. On the instrument, the alarm set point is designated as “S/P”. The set point is adjustable to any valid chlorine level over the range of the instrument in steps of 0.01 mg/L. This setting is not available if the Error function is chosen.

7.4.1 Alarm 1

Alarm 1 function:
The **ALM1** is displayed and the display indicates the current function of alarm 1 (**HI**, **LO**, **OFF, or Error**). Use the ▲ or ▼ buttons to cycle through and select the desired function. Press the **OK** button to accept the selection.

If the alarm was turned **OFF,** a prompt will appear to set up alarm 2 (go to section 7.4.2). If, on the other hand, one of the other functionalities was selected, a prompt will appear to set the delay times.

Alarm 1 set point:
This prompt is used to select the set point for this alarm; this is indicated by “S/P” shown on the lower row of the display. Select the desired alarm level by using the ▲ or ▼ buttons. Once the desired set point has been set, press the **OK** button to accept it.

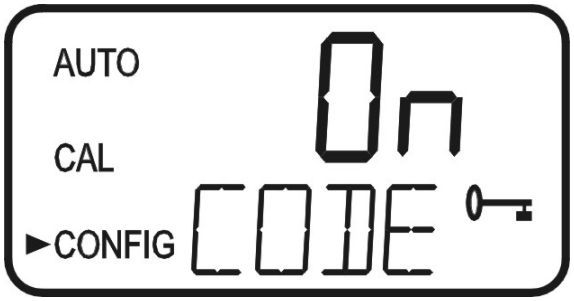
7.4.2 Alarm 2

Repeat the procedure listed in section 7.4.1 to set up the parameters for alarm 2. If a selection was made to turn the alarm **OFF**, the next selection for the speed of response **RESP** is shown. If one of the other functionalities is selected, a prompt to set the delay times and the set point, as with Alarm 1, will be displayed.

Note
Due to the cyclic nature of the Chlorine 3000, relay chatter is not an issue. There is no need for alarm delays or hysteresis.

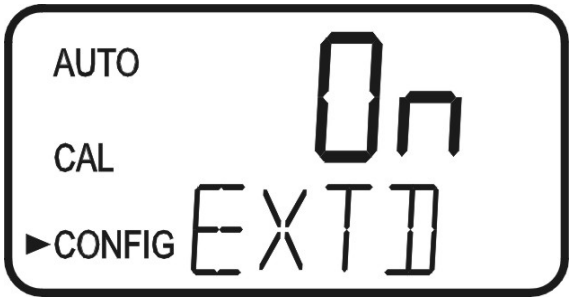
7.5 Enabling the security access

The instrument is equipped with a security access. If this option is turned on, the user is required to input the access code into the instrument to get to any mode other than **AUTO**. The only code is **333**. This code may not be changed. See section 5.2 for more information on this security feature. The security key icon will be visible and flashing on the display whenever the access option is selected using the ▲ or ▼ buttons (On or OFF).



7.6 Extended settings

The last few settings are grouped together with a compulsory guide to prevent them from being adjusted by accident. The "Extended settings" function is always switched off as the default setting. To gain access to the extended settings, select **On** using the ▲ or ▼ buttons and press the **OK** button.



7.6.1 Speed of response

The speed of response for both displayed and output values of mg/L can be adjusted in this menu. Although the factory setting is 1, thirty-one (0-30) response speeds are available. The higher the number selected, the slower the response will be. A high number could be used to ignore minor process variations in a slow changing process. A low number is used where a rapid response is desirable. Select the desired speed of response using the ▲ or ▼ buttons. Press the **OK** button to accept it.

To avoid reading minor process variations, select a slower speed. Select the fastest response (0 or 1) where monitoring of rapid changes is needed.

Assuming the cycle time is left at the factory setting of 2.5 minutes, the chart below will show typical response times to a single step change.

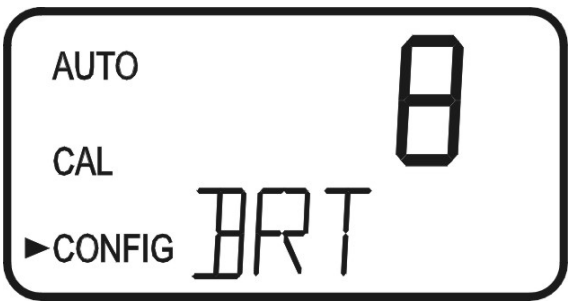
Response Setting	50% of Step Change	100% of Step Change
1*	**	7.5 minutes
5	7.5 minutes	42.5 minutes
10	15 minutes	1 hour, 17.5 minutes
20	22.5 minutes	2 hours, 20 minutes
30	27.5 minutes	3 hours

* Factory Setting
** Reading will not reach 50% of change in two cycles

Increasing the cycle time will increase the times shown in the table.

7.6.2 LCD backlight brightness

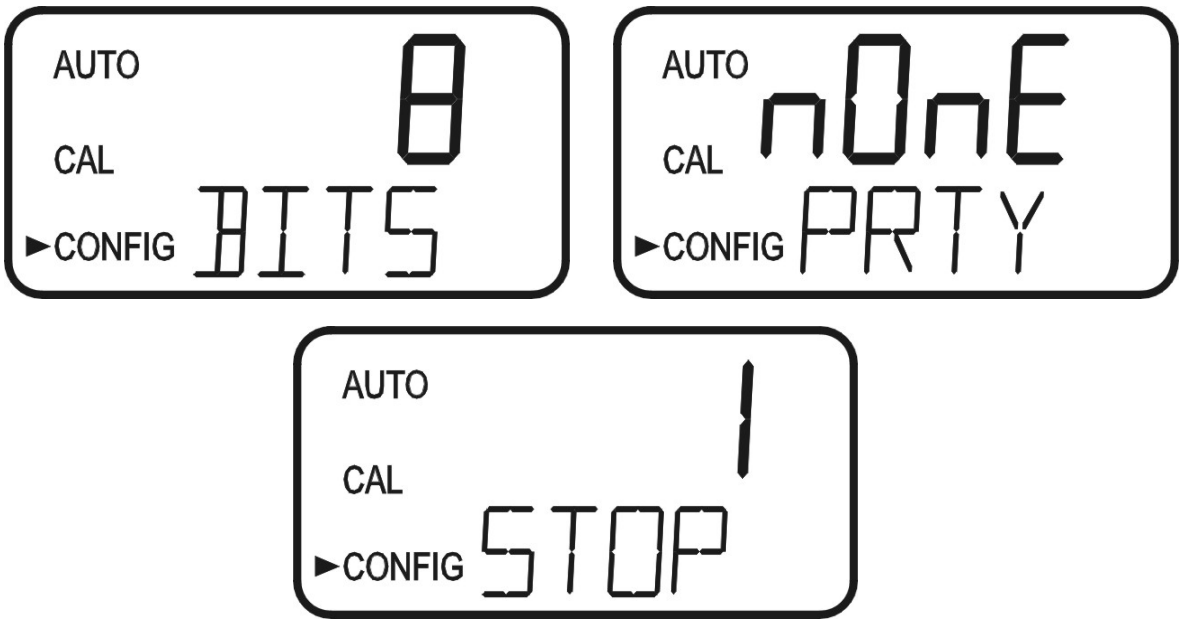
The LCD backlight brightness may need to be adjusted. This is of particular interest if multiple instruments are located in the same area and it is desired for the entire group to have the same appearance. Ten levels are available. The default brightness is 8.



Change the brightness by pressing the ▲ or ▼ button. When the desired brightness has been selected, press the **OK** button.

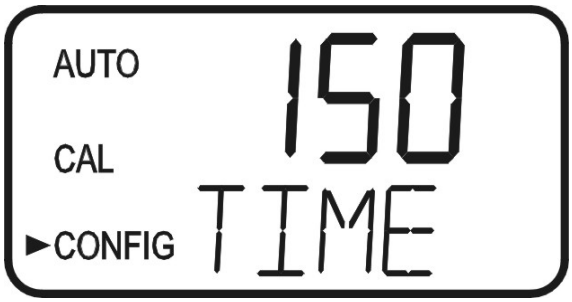
7.6.3 RS 485 Parameters

These menus will only appear if the RS 485 is enabled (see section 7.3). The default is 8 Bit, no (nOnE) Parity, 1 Stop Bit. Make selections using the ▲ or ▼ buttons then press the **OK** button to move to the next menu.



7.6.4 Cycle time

The cycle time can be changed using this menu. **Please note that changing this menu will directly affect the volume of reagent that will be consumed.** The default is set to 150 seconds (2 ½ minutes). Using this setting the reagents will last 30 days. Make selections using the ▲ or ▼ buttons then press the **OK** button to move to exit to **AUTO** mode. Allowable setting is from 110 to 600 seconds (10 minutes).



Note
Reagents will expire after 30 days independent of the cycle time settings.
Reagents may run empty before 30 days if the cycle time is shorter than 150 seconds.

7.7 Saving configuration settings

If extended settings are set to **OFF**, pressing the **OK** button will save all settings and the Chlorine 3000 will automatically return to the normal **AUTO** mode of the instrument.

If extended settings are set to **On**, after the last menu of the extended settings, pressing the **OK** button will save all settings and the Chlorine 3000 will automatically return to the normal **AUTO** mode of the instrument.
The **CONFIG** menu may be used at any time to reset or change any of the parameters. The **CONFIG** menu may be exited at any point in the menu by using the **MODE/EXIT** key. Any features that have been modified will be saved.

8 Additional features and options

8.1 RS 485 outputs

The Chlorine 3000 has the capability to operate in different RS 485 modes. Included is a simple communication mode and Modbus communication. All modes will automatically configure and do not require any changes or selections.

8.1.1 Simple communication

The Chlorine 3000 can provide basic communications over simple programs such as the Hilgraeve HyperTerminal that is included with most Microsoft Windows packages. The user could also use Visual Basic or other programs. The default communication parameters are: 8 bits, no parity and 1 stop bit. These can be changed in the Extended **CONFIG** menus (see section 7.6.3 RS 485 PARAMETERS).

The master computer will send out:

- Byte #1 the attention character "**:**" in ASCII or **3A** Hex
- Byte #2 the address of the Chlorine 3000 being queried
- Byte #3 & 4 CR LF or 0D 0A in hex

The Chlorine 3000 will respond with:

- The same attention character "**:**" in ASCII or **3A** Hex
- The address of the Chlorine 3000
- The Reading
- The Unit (mg/L)

A sample communication would look like this:

(Master computer requesting a report from address #1)	**:1 CRLF**
(Chlorine 3000 set to address #1 Response)	**:001 0.0249mg/L**

8.1.2 Modbus communication

Information on Modbus communication is given in a separate operating manual (available on the Internet under **www.WTW.com**).

9 Error elimination

9.1 Trouble shooting

The Chlorine 3000 performs continuous diagnostic monitoring. In the Chlorine 3000, there are four severity levels of fault detection. Level 4, 3 & 2 will allow normal operation, but warn of the problem. Level 1 is an instrument failure and the instrument will not operate. Any faults are displayed in a queue form in the bottom row of the LCD.

A **level 4 fault** is simply a screen indication that one of the alarm levels has been activated. This fault level will not affect the 4-20 mA and will only affect the alarm activated. The sample back light blinks at a rate of once every 4 seconds.

A **level 3 fault** indicates a failure or a problem that usually can be corrected by the operator. Refer to the chart below. If any of these errors occur, the instrument will still display readings and probably will operate correctly. These faults will self-clear when the problem is corrected. If this fault occurs it will affect the 4-20mA and any alarm set for fault detection (Error). The sample back light blinks at a rate of once every 2.5 seconds.

Level 3 (Self-Clearing) fault conditions

Message	Description of fault	Remedy
MA	4-20 mA enabled & loop open	Check 4-20 mA wiring, or turn off 4-20 mA if not used
CAL	Calibration invalid –not accepted	Recalibrate if needed
WATR	No water flowing	Check water flow
FAST	Intake water flow too fast	Set flow rate (see section 4.6)
SLOW	Sample cuvette filling too slowly	Set flow rate (see section 4.6)
PURG	Sample cuvette has slow purge	Check drain lines
NPRG	Sample cuvette not purging	Check drain lines
ISOL	Problem with intake solenoid	Check wiring, check for clogged solenoid
PSOL	Problem with purge solenoid	Check wiring, check for clogged solenoid
RGNT	Problem with reagent	Check reagent and lines
GLAS	Dirty cuvette	Replace or clean cuvette
WCAL	Water Level Calibration Invalid	Clear fault (see section 9.2)

A **level 2 fault** indicates a severe problem that will usually require technical assistance from WTW customer service. The queued display will show **POST**. If this fault occurs it will affect the 4-20mA and any alarm set for fault detection (Error). The sample back light blinks at rate of once every 1 second.

A **level 1 fault** is a system fault. This is NOT a problem that the operator can correct, and the unit must be returned to WTW for service. These failures consist of failures in the CPU, A/D, EEPROM or other devices internal to the instrument. The queued display will show **FAIL**, the upper display is a five digit code. If this fault occurs it will affect the 4-20mA and any alarm set for fault detection (Error). The instrument will not operate with this fault. The sample back light blinks at rate of once every 0.4 seconds.
If any fault conditions occur, the message indicating the fault will be shown on the lower row of the display.

9.2 Clearing faults

Every time the SERVICE mode is exited, all faults are cleared. If the original fault or a new fault occurs, it will be posted.

9.3 Reagent clogs

If reagents fail to flow or Prime it may be due to a clog in either the tubing or at a check valve. To alleviate this you may have to flush the system with Chlorine Free water, preferably Deionized water. See section 10.3 CHECK VALVE FLUSHING KIT.

9.4 Diagnostic Chart

Symptom	**Cause**	**Remedy**
Lower display shows **MA**	4-20 mA loop open	Check wiring, see sections 4.2.4 and 7.2
Lower display shows **FAIL**	Major system fault	See section 9.1
Readings are erratic	Bubbles in solution	See above
	Debris in flow	Install in-line strainer at inlet
Readings are lower than expected	Condensate or leaky measurement cuvette	Install desiccant pack
	Measurement cuvette dirty	Replace or clean cuvette
	Reagents bad or expired	Replace reagents
	Buffer reagent not being dispensed	Check buffer lines and check valves
Reagents bad or expired	Replace reagents	Reagents bad or expired
Upper display shows nOnE while attempting to calibrate	No current reading displayed	Wait for Chlorine 3000 to post a reading

10 Maintenance

10.1 Maintenance schedule

The recommended schedule is shown below. It is important to replace the reagents on a monthly basis to get reliable accurate readings from the Chlorine 3000.

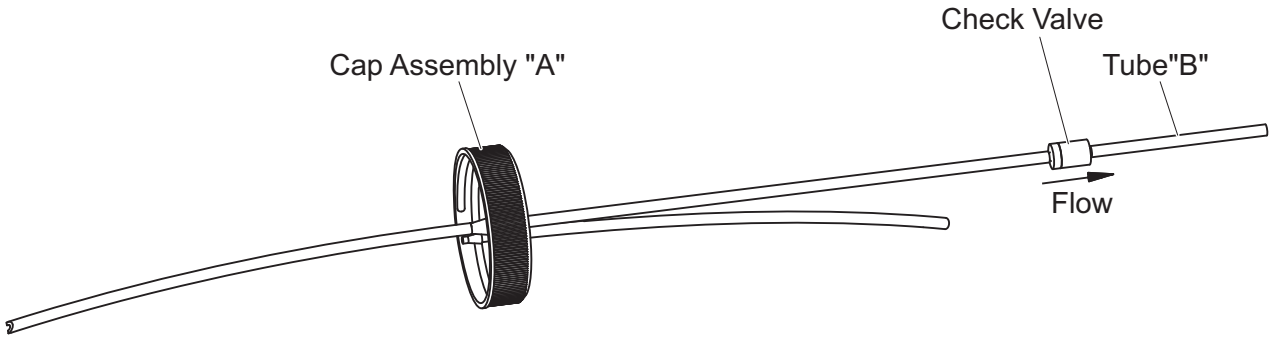


Fig. 6: Reagent tubings

Figure 6 shows one complete TECL-Kit reagent tubing set (check valve is not included in the kit). Two complete sets are used in the Chlorine 3000; one for the buffer and one for the indicator. The supplied kit is intended to last for one year. Additional kits can be ordered from WTW or your local WTW distributor or representative. It is recommended to keep one kit on hand at all times.

Generally, all “B” tubes should be replaced on a three month basis. The “A” cap assemblies and the cuvette should be replaced annually.

Every month

1. The reagents required for operating this instrument must be changed on a monthly basis (with a 2.5 minute cycle time, setting of the cycle time see section 7.6.4).
2. The in-line strainer should be checked and cleaned if necessary.
3. The glass cuvette should be inspected. Check for excessive debris on the inside surface of the glass. It is suggested to keep a spare cuvette to replace when required. The old cuvette may be cleaned, if possible, at a convenient time for future replacement.

WARNING
Improper handling of the chemicals may cause severe damage to your health (poisoning, corrosion). The safety datasheets of the chemicals used must be read carefully. Follow the protective measures stated there. In any case, wear appropriate protective clothing such as protective goggles, gloves etc.

Flushing the system

It is recommended that the tubings replacements be timed with reagent replacement. Press the **SERVICE** button to stop the water flow. Remove old reagents and discard. Place the inlet tubings in a small container of clean water. Press **SERVICE** to return to operation mode, press **PRIME** and then **OK** to flush the system with water. Remove the inlet tubings from the water. Press **PRIME** then **OK** to remove most of the water.

Note
After a PRIME the Chlorine 3000 will perform a water calibration (WCAL). It will take a few minutes to complete this procedure.

3 Month tubing replacement

The “B” tubings need replacement more often due to the fact that they are either in contact with both reagents or are subject to wear from the reagent “Pump”. The check valves should not need to be replaced and should be saved. Please note that the check valves are directional and that the “IN” side is smaller in diameter (see Fig. 6).

Steps:

1. Flush the system as described above to reduce personal contact with the reagents.
2. Press **SERVICE** to stop the flow of sample water and drain the cuvette.
3. Remove and retain the thumb screw and washer on top of the pump; pull the pump hammer and coil spring up and out of the way. There is no need to completely remove the hammer and spring.
4. Working on one reagent side at a time. Replace the “B” (black) tubing between optics inlet and the check valve OUTLET. Discard the old “B” tubing
5. Ensure the check valve is placed into its seat.
6. Repeat steps 4 & 5 for the other reagent.
7. Replace the hammer and spring back into place and secure with the thumb screw.
8. Check the drawing on the following page to ensure correct installation.
9. Return to operation as described.

Annual tubing replacement

Once a year, complete the 3 month tubing replacement as above, and then follow the steps below:

1. Replace the two “A” Cap Assemblies.
2. Turn the knurled top on the optics system counterclockwise (as viewed for the top) until the cuvette just “pops” out, but do not remove the top.
3. When the cuvette “pops” out, move the retaining o-ring & remove the cuvette. You may need a stiff wire such as a bent paper clip to grasp the cuvette. Retain this cuvette for future use if it can be cleaned.
4. Install the new cuvette by pushing it firmly in place and turning the knurled top clockwise until the cuvette is held securely.
5. Check the drawing on the following page to ensure correct installation.
6. Return to operation as described.

Return to normal operation

Press the **SERVICE** button to return sample flow to the system. Check for leaks. If a leak occurs press **SERVICE** again to empty the system. Repair the leak and try again. Once the system is operating correctly, return or replace reagents and press **PRIME** and then **OK** one time to restart reagent flow. The system will automatically return to normal operation.

Note
The tubes may darken due to contact with the reagent. This does not affect the performance of these parts.

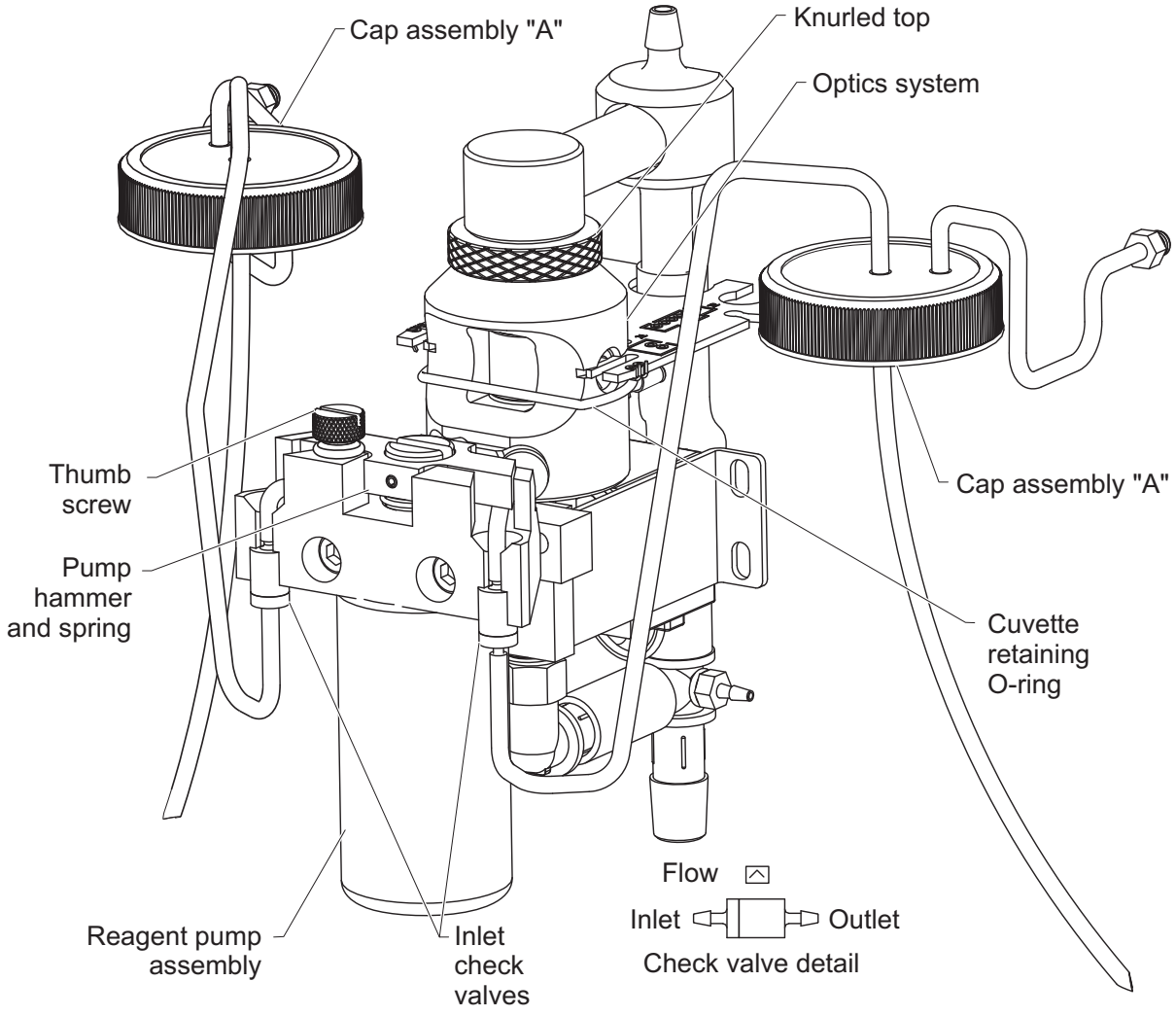


Fig. 7: Connecting the reagents

10.2 Replacing the reagents

WARNING
Improper handling of the chemicals may cause severe damage to your health (poisoning, corrosion). The safety datasheets of the chemicals used must be read carefully. The protective measures mentioned there must be followed. In any case, wear appropriate protective clothing such as protective goggles, gloves etc.

To replace the reagents, press the **SERVICE** button; this will empty the cuvette and stop any flow of water. Remove the cap on both bottles replace with the reagent bottle cap supplied in the Chlorine 3000. Make sure to insert the reagents in the correct position (buffer left, indicator right). The suction tube for both reagents will reach the bottom of the bottles.

To complete the replacement procedure, press the **PRIME** button and then the **OK** button. This will draw enough of each reagent to completely prime the tubes and replace any old solution. The system will automatically return to normal operation after it has primed.

Note
It may take about ½ hour after priming before accurate readings are displayed.

10.3 Check valve flushing kit

WARNING
Improper handling of the chemicals may cause severe damage to your health (poisoning, corrosion). The safety datasheets of the chemicals used must be read carefully. The protective measures mentioned there must be followed. In any case, wear appropriate protective clothing such as protective goggles, gloves etc.

Sometimes upon initial commissioning, the check valves stick and require manual priming. This should not be needed after commissioning. Be careful when using this kit to use only chlorine free water.

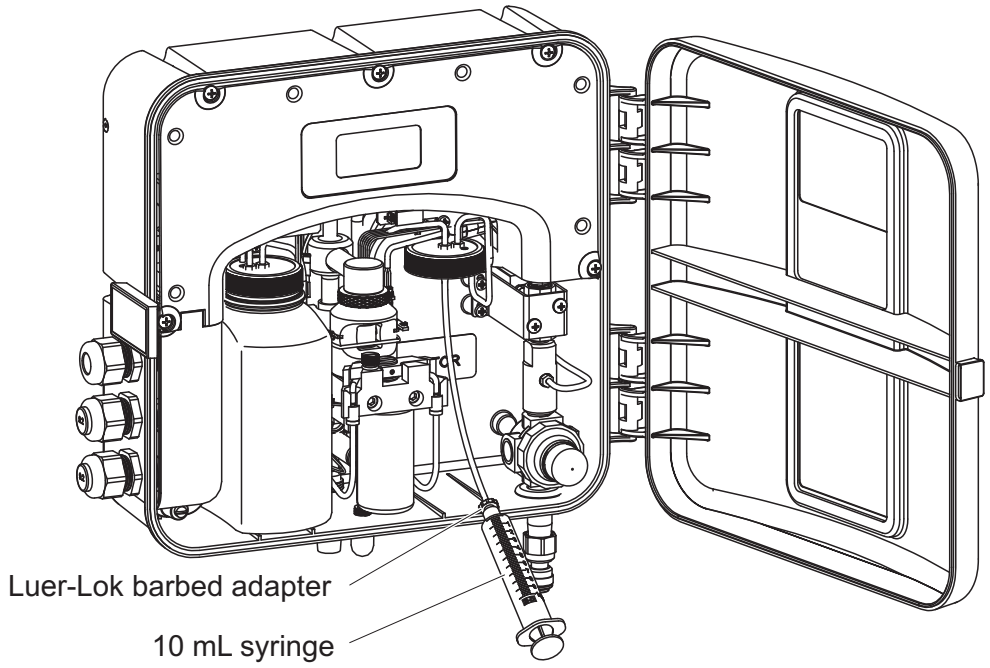


Fig. 8: Check Valve Flushing Kit

Flushing instructions:

1. Remove the parts from the packaging and install the barbed fitting on the end of the syringe.
2. Remove one of the cap assemblies from one of the reagent bottles.
3. Fill the syringe by drawing back the plunger with the end of the barbed fitting in DI water. Note: Use only chlorine free water.
4. Insert the barbed fitting into the end of the tubing coming from the bottle cap.
5. Depress the syringe plunger until all of the DI water is evacuated from the syringe.
6. Repeat as often as necessary until the DI water is easily dispensed from the syringe.
7. Repeat the above steps for the other reagent side.
8. After you are satisfied that the Check Valves and Tubing are thoroughly flushed, replace the reagent bottles and prime the pump by depressing PRIME on the touch pad.

10.4 Cuvette change

As recommended in section 10.1 MAINTENANCE SCHEDULE the cuvette should be inspected at monthly intervals and replaced when needed.

To replace the cuvette, press the **SERVICE** key. When HOLD shows on the screen, the system is ready.

CAUTION
The cuvette is spring loaded to allow for removal. Leave the cuvette retainer (O-ring) in place while loosening top.

1. Turn the knurled top on the optics system counterclockwise (as viewed for the top) until the cuvette just “pops” out, but do not remove the top.
2. When the cuvette “pops” out, move the retaining O-ring and remove the cuvette. You may need an aid such as a bent paper clip to grasp the cuvette. Retain this cuvette for future use if it can be cleaned.
3. Install the new cuvette by pushing it firmly in place and turning the knurled top clockwise until the cuvette is held securely. To avoid damage do not over tighten the knurled top.
4. Press the **SERVICE** button; the system returns to normal sample flow. Check for leaks. Return to normal operation.

10.5 Instrument storage

If the Chlorine 3000 is relocated or will be inactive for more than 48 hours, remove the reagents. Flush the reagent system as described in 10.1 Maintenance schedule. Place the instrument in Service mode to drain the system then remove power by disconnecting the mains power plug. It is usually a good idea to disconnect or shut off the source water.

WARNING
Improper handling of the chemicals may cause severe damage to your health (poisoning, corrosion). The safety datasheets of the chemicals used must be read carefully. The protective measures mentioned there must be followed. In any case, wear appropriate protective clothing such as protective goggles, gloves etc.

10.6 Cleaning the Chlorine 3000

Flush the system as mentioned in section 10.1 MAINTENANCE SCHEDULE. When the flushing is finished, press the SERVICE button wait until the display reads HOLd.

As a mater of safety, always disconnect any power source to the Chlorine 3000 prior to attempting any cleaning. It is recommended that the source water is also shut off.

Isopropyl alcohol (rubbing alcohol) on a soft cotton cloth works very well in removing reagent stains from plastic parts, the key pad and the display. Use care when cleaning around electrical components. Do not use any harsh cleaning agents as these may cause damage to the instrument components.

CAUTION
Ensure that the system is dry prior to applying power.

11 Technical data

Measuring range	0 – 10 mg/L Cl_2 (ppm)	
Accuracy	0 – 6.00 mg/L Cl_2 (ppm)	±5 % of reading or ±0.03 mg/L Cl_2 (ppm), whichever is greater
	6.01 – 10.00 mg/L Cl_2 (ppm)	±10 % of reading
Resolution	0.01 mg/L Cl_2 (ppm)	
Cycle time	adjustable: 110 seconds to 10 minutes (600 seconds) (defaults to 2.5 minutes)	
Display	Multi-line liquid crystal backlit display	
Alarms	Two programmable, 120-240VAC 2A form C relay	
Analog output	Powered 4-20 mA, 600 Ω drive, isolated	
Communications port	Bi-directional RS 485 with Modbus	
Water pressure	Integral pressure regulator 0.34…10.3 bar (34…1030 kPa, 5.0…150 psi)	
Flow rate	200 – 400 mL/min	
Operating temperature	5 °…40 °C (41 °…104 °F)	
Wetted materials	PVC, borosilicate glass, Reslyn (FFKM), Viton® (FKM), Polypropylene, stainless steel, acetal, Nitrile, Noryl®, Nylon	
Sample temperature range	5 °…40 °C (41 °…104 °F)	
Power Supply	100 – 240 VAC, 47 – 63 Hz, 150VA	
Insulation rating	Double insulated, pollution degree 2, overvoltage category II	
Environmental conditions	Not recommended for outdoor use. Altitude up to 2000 meters Up to 95 % RH (non-condensing)	
Enclosure rating	Designed to meet IP 66 /NEMA 4X	
Regulatory compliance and certifications	CE approved, ETL listed to UL 61010-1-2004 & ETL certified to CSA 22.2 No. 61010.1 2nd edition dated July 2004	
Weight	2.5 kg (5.5 lbs.), without reagents	
Shipping dimensions	406 mm X 406 mm X 229 mm (16”X 16” X 9”)	

12 Replacement parts and accessories

The items shown below are recommended accessories and replacement parts.

To order any accessory or replacement part, please contact the WTW customer service department. If for any reason technical assistance is needed regarding this instrument please do not hesitate to contact the WTW technical services department.

Model	Designation	WTW order no.
Flow-through cuvette	FTCL-Kit	860185
Replacement tubing and cuvette kit	TECL-Kit	860180
Check valve flushing kit	FlushKit	860156
Zero point calibration set 240 Volt	Z-Kal-Kit 240 VAC	860190
Zero point calibration set 115 Volt	Z-Kal-Kit 115 VAC	860191
Reagent set for measurement of Free chlorine, 30 days supply	CLDF-Kit 30	860160
Reagent set for measurement of Total chlorine, 30 days supply	CLDT-Kit 30	860165
Reagent set for measurement of Free chlorine, 12 months supply	CLDF-Kit 360	860170
Reagent set for measurement of Total chlorine, 12 months supply	CLDT-Kit 360	860175

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