On-Site Determination of Chlorine

A. PURPOSE AND SCOPE

Details the on-site measurement of free and total chlorine in water samples using the Palintest DPD,GP/HR and HACH DPD methods.

B. CONTENTS

C. CHANGES IN THIS DOCUMENT

DESCRIPTION OF CHANGE
3.3 3.7 3.9 3.11 reference to rinsing crusher stick
Addition of HACH DPD method, update contents table, add number formatting 4. Free, combined and total chlorine, typos removed, and departmental titles updated.

D. RECORDS / FORMS / LOGS

REFERENCE	TITLE	LOCATION
FM-QSC-0013	Photometer Validation Records	Intranet
FM-QSC-0015	Comparator Validation Records	Intranet
FM-QSC-0027	Photometer Tables	Intranet
	Test Certificate	Accompanies Standards
FM-QSC-0012	HACH AQC Record sheet	Intranet
FM-QSM-0007	Non-Conforming Work Record	Intranet

E. REFERENCES

REFERENCE	TITLE	LOCATION
QSC-011a	Palintest 1000 Chlorometer Operating Instructions	Intranet

F. PROCEDURE

1. Reagent Shelf Life

Boxes of tablet DPD reagents are issued with a best-before date. The life of the tablets is 10 years.

Reject reagents where the best-before date has passed.

Upon opening liquid reagents mark them with an 'opened on' date. Reject liquid reagents where more than 1 month has passed since the 'opened on' date.

2. Instrument Traceability and Care

Mark all photometers and comparators with a unique customs number. Comparator discs are identified by either a customs number or the manufacturer's serial number.

Ensure portable measurement equipment is kept clean and stored according to the manufacturer's recommendations. Replace batteries when required.

3 Measurement

3.1 0 - 5 mg/l Chlorine Using a Photometer 5000.

- Flush the sample point in order to obtain a representative sample.
- Select 520nm wavelength on photometer 5000.
- Rinse and fill to the 10ml mark the BLANK sample tube with the water under test and wipe to dry using blue tissue or similar lint free cloth.
- Rinse SAMPLE tube with the water under test leaving 2-3 drops of sample in the tube.
- Add one DPD No1 tablet, crush tablet with a clean crusher and then fill SAMPLE tube with the water under test to the 10ml mark. Mix to dissolve tablet and wipe to dry using blue tissue or similar lint free cloth.

Note: The process of crushing and mixing DPD No 1 tablets sometimes generates air bubbles and complete dissolution of the tablet is not always possible. Prior to measurement ensure any air bubbles formed are dislodged and any un-dissolved tablet has settled.

- Place BLANK tube into test chamber.
- Press the ON button. Keep depressed until the display reads 100 (100% Transmittance).
- Release ON button. Remove blank tube and place in tube holder.
- Place SAMPLE tube in the test chamber. Note the display reading when steady. Instrument turns off automatically after 6-8 seconds.
- Compare displayed reading (%T) against the Table 1 in Appendix 1 or with the appropriate table on FM-QSC-0027.
- The result represents the FREE chlorine residual in mg/l.

- If it is desired to measure combined or total chlorine continue the test on the same test portion.
- Add one DPD No 3 tablet, crush with a clean crusher and mix to dissolve.
- Stand for at least 2 minutes and not more than 20 minutes to allow full colour development.
- Place BLANK tube into test chamber.
- Press the ON button. Keep depressed until the display reads 100 (100% Transmittance).
- Release ON button. Remove blank tube and place in tube holder.
- Place SAMPLE tube in the test chamber. Note the display reading when steady. Instrument turns off automatically after 6-8 seconds.
- Compare displayed reading (%T) against the Table 1 in Appendix 1 or with the appropriate table on FM-QSC-0027.
- The result represents the TOTAL chlorine residual in mg/l.

On completion of test, empty, rinse and dry glass sample tube before storage. This will prevent discolouration of tube, which may affect future sample results.

3.2 0-5 mg/l Chlorine Using a Photometer 7000

- Flush the sample point in order to obtain a representative sample.
- Press [ON] key (or press [0] and [ON] keys for continuous operation) and select method Phot 7.
- Rinse and fill to the 10ml mark the BLANK sample tube with the water under test and wipe to dry using blue tissue or similar lint free cloth.
- Rinse SAMPLE tube with the water under test leaving 2-3 drops of sample in the tube.
- Add one DPD No1 tablet, crush tablet with a clean crusher and then fill SAMPLE tube with the water under test to the 10ml mark. Mix to dissolve tablet and wipe to dry using blue tissue or similar lint free cloth.

Note: The process of crushing and mixing DPD No 1 tablets sometimes generates air bubbles and complete dissolution of the tablet is not always possible. Prior to measurement ensure any air bubbles formed are dislodged and any un-dissolved tablet has settled.

- Press ENTER until the following message appears ‘INSERT BLANK’. Place BLANK tube into test chamber and press enter.
- The instrument will be set automatically and after a few seconds the following display will appear - ‘INSERT SAMPLE’.
- Place SAMPLE tube in the test chamber and press ENTER.
- The result displayed represents the FREE chlorine residual in mg/l.
- If it is desired to measure combined or total chlorine continue the test on the same test portion. Press [★] to continue.
- Add one DPD No 3 tablet, crush with a clean crusher and mix to dissolve.
- Stand for at least 2 minutes and not more than 20 minutes to allow full colour development.
- Press the ENTER button.
- The result displayed represents the TOTAL chlorine residual in mg/l.

On completion of test, empty, rinse and dry glass sample tube before storage. This will prevent discolouration of tube, which may affect future sample results.

3.3 0-5 mg/l Chlorine Using a DPD Liquid Reagents using Photometer 5000 or 7000

If a crusher stick is used to stir the sample, it must be thoroughly rinsed before each and every use.

Follow the appropriate instructions above using the following quantities of liquid reagents in place of DPD No 1 and No3 tablets;

- DPD No 1 Tablet = 3 drops of DPD No 1 Indicator (Solution A) followed by 3 drops of DPD No1 Buffer (Solution B).
- DPD No 3 Tablet = 3 drops of DPD No 3 (Solution C).

On completion of test, empty, rinse and dry glass sample tube before storage. This will prevent discolouration of tube, which may affect future sample results.

3.4 0-1, 0-2 or 0-5mg/l Chlorine using a Comparator and Discs

- Flush the sample point in order to obtain a representative sample.
- Insert chlorine disc into comparator ensuring the numbers are facing you.
- Rinse sample tube with water under test leaving 2-3 drops of sample in the tube.
- Rinse and fill to the 10ml mark the blank sample tube and wipe to dry using blue tissue or similar lint free cloth.
- Add one DPD No1 tablet, crush with a clean crusher and then fill tube with water under test to the 10ml mark. Mix to dissolve tablet and wipe to dry using blue tissue or similar lint free cloth.
- Place the sample tube in the right-hand side of the tube holder. Place the blank tube in the left-hand side of the tube holder.
- Hold the comparator against a source of white light and rotate the disc until the intensity of colour is seen to match.
- Take the disc reading which appears in the aperture on the front of the comparator.
- The result displayed represents the FREE chlorine residual in mg/l.
- If it is desired to measure combined or total chlorine continue the test on the same test portion.
- Add one DPD No 3 tablet, crush with a clean crusher and mix to dissolve.
- Stand for at least 2 minutes and not more than 20 minutes to allow full colour development.
- Replace the sample tube into the right-hand side of the comparator.
- Hold the comparator against a source of white light and rotate the disc until the colours are seen to match.
- Take the disc reading which appears in the aperture on the front of the comparator.
- The result displayed represents the TOTAL chlorine residual in mg/l.

Note: A too high chlorine level (above 10mg/l) can cause bleaching of the pink coloration in the above tests and give a false negative result.

On completion of test, empty, rinse and dry glass sample tube before storage. This will prevent discolouration of tube, which may affect future sample results.

3.5 0-50 and 0-250mg/l Chlorine using a Comparator and Discs

- Flush the sample point in order to obtain a representative sample.
- Insert chlorine disc into comparator ensuring the numbers are facing you.
- Rinse sample tube with water under test and then fill tube with sample to the 10ml mark.
- Add one Acidifying GP and one Chlorine HR tablet, crush with a clean crusher, mix to dissolve and wipe to dry using blue tissue or similar lint free cloth.
- Rinse and fill to the 10ml mark the blank sample tube and wipe to dry.
- Place the sample tube in the right-hand side of the tube holder. Place the blank tube in the left-hand side of the tube holder.
- Hold the comparator against a source of white light, and rotate the disc until the colours are seen to match.
- Take the disc reading which appears in the aperture on the front of the comparator.
- The result displayed represents the chlorine residual in mg/l.

On completion of test, empty, rinse and dry glass sample tube before storage. This will prevent discolouration of tube, which may affect future sample results.

3.6 0-5 mg/1 Chlorine using DPD tablets using a Palintest 1000 Chlorometer

Palintest 1000 Chlorometer must be maintained and cared for according to manufacturers instructions QSC-011a.

Ensure crushing stick is thoroughly rinsed before use.

- Flush the sample in order to obtain a representative sample.
- Rinse and fill the SAMPLE tube to the 10ml mark with the water under test and wipe dry using blue tissue or similar lint free cloth.
- Insert the SAMPLE tube into the test chamber with the ◊ on the test tube facing the user.
- Press and hold down the ON key until the --- symbol appears on the display.
- Release the ON key when the display shows 0.00. This zero setting will be held in the memory. The machine has now been Blanked against the sample being tested.
- Rinse the SAMPLE tube with the water under test leaving 2-3 drops of sample in the tube.
- Add one DPD No 1 tablet, crush tablet with clean crusher and then fill the SAMPLE tube with the water under test to the 10ml mark. Mix to dissolve tablet and wipe to dry using blue tissue or similar lint free cloth.

Note: The process of crushing and mixing DPD No1 tablets sometimes generates air bubbles and complete dissolution of the tablet is not always possible. Prior to measurement ensure any air bubbles formed are dislodged and any un-dissolved tablet has settled.

- Insert the SAMPLE tube into the test chamber with the ◊ on the test tube facing the user.
- Press the ON key until the display appears. (Do not hold the key down or the instrument will attempt to blank on the sample and cause errors on the readings).
- The test reading for the sample will be displayed.
- The result represents the FREE chlorine residual in mg/l.
- If it is desired to measure combined or total chlorine continue the test on the same test portion.
- Add one DPD No 3 tablet, crush with a clean crusher and mix to dissolve.
- Stand for at least 2 minutes and no more than 20 minutes to allow full colour development.
- Insert the SAMPLE tube into the test chamber with the ◊ on the test tube facing the user.
- Press the ON key until the display appears. (Do not hold the key down or the instrument will attempt to blank on the sample and cause errors on the readings).
- The test reading for the sample will be displayed.
- The result represents the TOTAL chlorine residual in mg/l.

On completion of test, empty, rinse and dry glass sample tube before storage. This will prevent discolouration of tube, which may affect future sample results.

3.7 0-5 mg/l Chlorine Using DPD Liquid Reagents using Palintest 1000 Chlorometer

- DPD No 1 Tablet = 3 drops of DPD No 1 Indicator (Solution A) followed by 3 drops of DPD No1 Buffer (Solution B).

- DPD No 3 Tablet = 3 drops of DPD No 3 (Solution C).

- Flush the sample in order to obtain a representative sample.
- Rinse and fill the SAMPLE tube to the 10ml mark with the water under test and wipe dry using blue tissue or similar lint free cloth.
- Insert the SAMPLE tube into the test chamber with the ◊ on the test tube facing the user.
- Press and hold down the ON key until the --- symbol appears on the display.
- Release the ON key when the display shows 0.00. This zero setting will be held in the memory. The machine has now been Blanked against the sample being tested.
- Add three drops of solution A and three drops of solution B to the sample.
- Place lid on tube and shake sample to mix.
- Insert the SAMPLE tube into the test chamber with the ◊ on the test tube facing the user.

- Press the ON key until the display appears. (Do not hold the key down or the instrument will attempt to blank on the sample and cause errors on the readings).
- The test reading for the sample will be displayed.
- The result represents the FREE chlorine residual in mg/l.
- If it is desired to measure combined or total chlorine continue the test on the same test portion.
- Add three drops of solution C. Replace lid and shake to mix.
- Stand for at least 2 minutes and no more than 20 minutes to allow full colour development.
- Insert the SAMPLE tube into the test chamber with the ◊ on the test tube facing the user.
- Press the ON key until the display appears. (Do not hold the key down or the instrument will attempt to blank on the sample and cause errors on the readings).
- The test reading for the sample will be displayed.
- The result represents the TOTAL chlorine residual in mg/l.

On completion of test, empty, rinse and dry glass sample tube before storage. This will prevent discolouration of tube, which may affect future sample results.

3.8 0-5 mg/1 Chlorine using DPD tablets using a Palintest 1000 Duo Chlorometer

Palintest 1000 Duo Chlorometer must be maintained and cared for according to manufacturers instructions QSC-011a.

Ensure crushing stick is thoroughly rinsed before use.

- Flush the sample in order to obtain a representative sample.
- Rinse and fill the SAMPLE tube to the 10ml mark with the water under test and wipe dry using blue tissue or similar lint free cloth.
- Insert the SAMPLE tube into the test chamber with the ◊ on test tube aligned to Δ marking on the face of instrument.
- Press ON button and then press MENU button to select Lr (Lower Range).
- Press and hold down the ON key until the --- symbol appears on the display.
- Release the ON key when the display shows 0.00. This zero setting will be held in the memory. The machine has now been Blanked against the sample being tested.
- Rinse the SAMPLE tube with the water under test leaving 2-3 drops of sample in the tube.
- Add one DPD No 1 tablet, crush tablet with clean crusher and then fill the SAMPLE tube with the water under test to the 10ml mark. Mix to dissolve tablet and wipe to dry using blue tissue or similar lint free cloth.

Note: The process of crushing and mixing DPD No1 tablets sometimes generates air bubbles and complete dissolution of the tablet is not always possible. Prior to measurement ensure any air bubbles formed are dislodged and any un-dissolved tablet has settled.

- Insert the SAMPLE tube into the test chamber with the ◊ on the test tube aligned to Δ marking on the face of instrument.
- Press the ON key until the display appears. (Do not hold the key down or the instrument will attempt to blank on the sample and cause errors on the readings).
- The test reading for the sample will be displayed.
- The result represents the FREE chlorine residual in mg/l.
- If it is desired to measure combined or total chlorine continue the test on the same test portion.
- Add one DPD No 3 tablet, crush with a clean crusher and mix to dissolve.
- Stand for at least 2 minutes and no more than 20 minutes to allow full colour development.
- Insert the SAMPLE tube into the test chamber with the ◊ on the test tube aligned to Δ marking on the face of instrument.
- Press the ON key until the display appears. (Do not hold the key down or the instrument will attempt to blank on the sample and cause errors on the readings).
- The test reading for the sample will be displayed.
- The result represents the TOTAL chlorine residual in mg/l.

On completion of test, empty, rinse and dry glass sample tube before storage. This will prevent discolouration of tube, which may affect future sample results.

3.9 0-5 mg/l Chlorine Using DPD Liquid Reagents using Palintest 1000 Duo Chlorometer

- DPD No 1 Tablet = 3 drops of DPD No 1 Indicator (Solution A) followed by 3 drops of DPD No1 Buffer (Solution B).

- DPD No 3 Tablet = 3 drops of DPD No 3 (Solution C).

- Flush the sample in order to obtain a representative sample.
- Rinse and fill the SAMPLE tube to the 10ml mark with the water under test and wipe dry using blue tissue or similar lint free cloth.
- Insert the SAMPLE tube into the test chamber with the ◊ on test tube aligned to Δ marking on the face of instrument.
- Press ON button and then press MENU button to select Lr (Lower Range).
- Press and hold down the ON key until the --- symbol appears on the display.
- Release the ON key when the display shows 0.00. This zero setting will be held in the memory. The machine has now been Blanked against the sample being tested.
- Add three drops of solution A and three drops of solution B to the sample.
- Place lid on tube and shake sample to mix.
- Insert the SAMPLE tube into the test chamber with the ◊ on the test tube facing the user.
- Press the ON key until the display appears. (Do not hold the key down or the instrument will attempt to blank on the sample and cause errors on the readings).
- The test reading for the sample will be displayed.

- The result represents the FREE chlorine residual in mg/l.
- If it is desired to measure combined or total chlorine continue the test on the same test portion.
- Add three drops of solution C. Replace lid and shake to mix.
- Stand for at least 2 minutes and no more than 20 minutes to allow full colour development.
- Insert the SAMPLE tube into the test chamber with the ◊ on the test tube facing the user.
- Press the ON key until the display appears. (Do not hold the key down or the instrument will attempt to blank on the sample and cause errors on the readings).
- The test reading for the sample will be displayed.
- The result represents the TOTAL chlorine residual in mg/l.

On completion of test, empty, rinse and dry glass sample tube before storage. This will prevent discolouration of tube, which may affect future sample results.

3.10 0-5 mg/1 Chlorine using DPD tablets using a Palintest Chlorometer (Blue)

Palintest Chlorometer must be maintained and cared for according to manufacturers instructions QSC-011a.

Ensure crushing stick is thoroughly rinsed before use.

- Flush the sample in order to obtain a representative sample.
- Rinse and fill the SAMPLE tube to the 10ml mark with the water under test and wipe dry using blue tissue or similar lint free cloth.
- Press the on/off button to start the machine.
- Insert the SAMPLE tube into the test chamber and press the 'blank sample' button.
- An image displaying a blank tube will be displayed on screen. When this is replaced by 0.00 the instrument is finished blanking and ready to take a reading.
- Rinse the SAMPLE tube with the water under test leaving 2-3 drops of sample in the tube.
- Add one DPD No 1 tablet, crush tablet with clean crusher and then fill the SAMPLE tube with the water under test to the 10ml mark. Replace lid and shake to mix. Wipe to dry using blue tissue or similar lint free cloth.

Note: The process of crushing and mixing DPD No1 tablets sometimes generates air bubbles and complete dissolution of the tablet is not always possible. Prior to measurement ensure any air bubbles formed are dislodged and any un-dissolved tablet has settled.

- Insert the SAMPLE tube into the test chamber and press the 'Read Sample' button.
- The test reading for the sample will be displayed.
- The result represents the FREE chlorine residual in mg/l.
- If it is desired to measure combined or total chlorine continue the test on the

same test portion.
- Add one DPD No 3 tablet, crush with a clean crusher and mix to dissolve.
- Stand for at least 2 minutes and no more than 20 minutes to allow full colour development.
- Insert the SAMPLE tube into the test chamber and press the 'Read Sample' button.
- The test reading for the sample will be displayed.
- The result represents the TOTAL chlorine residual in mg/l.

On completion of test, empty, rinse and dry glass sample tube before storage. This will prevent discolouration of tube, which may affect future sample results.

3.11 0-5 mg/l Chlorine Using a DPD Liquid Reagents using Palintest Chlorometer (Blue)

- DPD No 1 Tablet = 3 drops of DPD No 1 Indicator (Solution A) followed by 3 drops of DPD No1 Buffer (Solution B).

- DPD No 3 Tablet = 3 drops of DPD No 3 (Solution C).

- Flush the sample in order to obtain a representative sample.
- Rinse and fill the SAMPLE tube to the 10ml mark with the water under test and wipe dry using blue tissue or similar lint free cloth.
- Press the on/off button to start the machine.
- Insert the SAMPLE tube into the test chamber with the ◊ on test tube aligned to Δ marking on the face of instrument and press the 'blank sample' button.
- An image displaying a blank tube will be displayed on screen. When this is replaced by 0.00 the instrument is finished blanking and ready to take a reading.
- Add three drops of solution A and three drops of solution B to the sample.
- Place lid on tube and shake sample to mix. Wipe to dry using blue tissue or similar lint free cloth.
- Insert the SAMPLE tube into the test chamber with the ◊ on the test tube aligned to Δ marking on the face of instrument.
- Press the 'Read Sample' button.
- The result represents the FREE chlorine residual in mg/l.
- If it is desired to measure combined or total chlorine continue the test on the same test portion.
- Add three drops of solution C. Replace lid and shake to mix.
- Stand for at least 2 minutes and no more than 20 minutes to allow full colour development.
- Insert the SAMPLE tube into the test chamber and press the 'Read Sample' button.
- The test reading for the sample will be displayed.
- The result represents the TOTAL chlorine residual in mg/l.

On completion of test, empty, rinse and dry glass sample tube before storage. This will prevent discolouration of tube, which may affect future sample results.

3.12 0-2 mg/l Chlorine using HACH Colorimeter II

Note: Do not use the same sample cells for free and total chlorine analysis without thoroughly rinsing the cells with sample between free and total tests. Ideally separate cells should be used and cells kept for just free or total tests.

1) Fill a 10ml cell to the mark with sample (the blank) and cap.
2) Press the **POWER** button to turn meter on, check the display indicates “LR” for low range.
3) Remove the meter cap, place the blank into the cell holder with the diamond facing the keypad, and place the meter cap over the cell compartment to cover the cell.
4) Press the **ZERO/SCROLL** button and check the meter displays “0.00”, and then remove the cell from the cell holder.
5) Fill a second 10ml cell to the mark with sample.
6) Add the contents of one DPD 1 Free Chlorine Powder Pillow to the cell re-cap and invert gently for 10 seconds avoiding any creation of bubbles.
7) Place the cell into the cell holder with the diamond facing the keypad; place the meter cap over the cell compartment to cover the cell.
8) Press the **READ/ENTER** button within 1 minute and note the reading of “--.—“mg/l Free Chlorine immediately on the sample run sheet/mobile computing device.
9) Fill a third 10ml cell to the mark with sample.
10) Add the contents of one DPD 3 Total Chlorine Powder Pillow to the cell re-cap and invert gently for 20 seconds.
11) Place the cell into the cell holder with the diamond facing the keypad; place the meter cap over the cell compartment to cover the cell.
12) Wait for between 3 and 6 minutes, then press the **READ/ENTER** button and note the reading of “x.xx“mg/l Total Chlorine immediately on the sample run sheet/ mobile computing device.

If the reading is not in line with the expected result, repeat the test 3 times. Record the first result where the next result is within 0.05 mg/l of agreement. If the discrepancy is >0.05mg/l contact the Principal Scientist.

On completion of test, empty, rinse and dry glass sample tube before storage. This will prevent discolouration of tube, which may affect future sample results.

Cell check

To ensure that test cells are not introducing errors, at least once per week (or anytime if suspected erroneous results are encountered), the following procedure must be carried out.

Place one dry cell in the cell holder with the diamond mark to the front. Replace the meter cap. Press the ZERO button to display “0.00”. Remove this cell and replace it with another cell to be tested. Replace the meter cap. Press the READ/ENTER button and note the reading. If the display flashes, it indicates the second cell is providing a lower result than the first. In this case, with the second cell still in the holder, press the ZERO button to display “0.00”. Remove this cell and replace it the first cell. Replace the meter cap. Press the READ/ENTER button and note the reading. Any positive reading must not be more than 0.02. Any cells that are showing more than a 0.02 discrepancy with each other must not be used.

4. Free, Combined and Total Chlorine.

Free chlorine is the measure of chlorine available to disinfect microorganisms.
When ammonia or organic nitrogen is also present, chloramines will quickly form.
Chloramines are also known as combined chlorine.
Total chlorine is the sum of free chlorine and combined chlorine.
The level of total chlorine will always be higher than or equal to the level of free chlorine.
If you get a Higher free result than a total result when taking measurements, follow the following steps:

1. Clean and dry all equipment and retest.
2. If problem persists clean, and dry equipment and retest.
3. If problem still persists open new reagents and retest.
4. If problem still persists contact the Duty Scientist and seek advice.

5. Recording Results

Record results on sample label, works/site log or form as appropriate.

6. Results at Service Reservoirs

Report results of less than 0.2mg/l free chlorine to **Distribution Depot Clerk, Distribution Team Leader, or Water Quality Scientist** and request reservoir chlorination.

Report results of greater than 1.5mg/l free chlorine to **Water Quality Scientist.**

7. Validation and Calibration

7.1. Photometer

- Validate photometer as described below on a daily basis or, if used less frequently than once a week, prior to each use.
- Using a certified, in-date photometer standard (520nm) and blank carry out a measurement as described in the relevant section above.
- Record the result along with the standard number, blank number and expiry date on form FM-QSC-0013 *Photometer Validation Records*. **Water Quality Technicians** record the result on FM-QSC-0025 *Sampling Technician's Photometer Validation and Fridge Cleaning Records.*
- Check result is within the test tolerance value quoted on the photometer Test Certificate.
- Only use photometers that give satisfactory validation results. If unsatisfactory validation results are obtained clean sample tubes and photometer wells and repeat test.

- If repeat test proves unsatisfactory return photometer to manufacturer for re-calibration.
- Inform appropriate **Water Quality Scientist** if the error on the photometer and the subsequent use of invalidated data is likely to have impacted on water quality.
- **Water Quality Scientist** will determine appropriate action.
- When complete FM-QSC-0013 is kept at local Water Quality Office, Water Distribution Depot, Water Treatment Office or Customer Service Office as appropriate to the user of the photometer.

7.2. Comparator (0-1, 0-2 and 0-5mg/l)

- Validate comparator as described below on an annual basis or, if used less frequently than once a year, prior to each use.
- Select a sample point where the free chlorine residual is at least 0.3 mg/l.
- Carry out an on-site determination of free chlorine using a photometer as described above and record on FM-QSC-0015 -'*Comparator Validation Records'*.
- Carry out an on-site determination of free chlorine using the comparator as described above and record on FM-QSC-0015.
- Subtract photometer result from comparator result and record on FM-QSC-0015.
- Check result is within the test value tolerance value quoted on FM-QSC-0015.
- Only use comparators that give satisfactory validation results. If unsatisfactory validation results renew comparator disc and dispose of the old one and record on FM-QSC -0015.
- Inform appropriate **Water Quality Scientist** if the error on the photometer and the subsequent use of invalidated data is likely to have impacted on water quality.
- **Water Quality Scientist** will determine appropriate action.
- When complete FM-QSC-0015 is kept at local Water Quality Office, Water Distribution Depot, Water Treatment Office or Customer Service Office as appropriate to the user of the photometer.

7.3. Comparator (0-50 and 0-250mg/l)

None required.

7.4. Palintest 1000 Chlorometer.

- Validate chlorometer as described below on a weekly basis or, if used less frequently than once a week, prior to each use.
- Water Quality Technicians are required to validate their instrument at the beginning and at the end of each day when chlorine measurements are required.
- Using certified, in date chlorometer standards (circa 0.20 and 1.00mg/l) and a blank carry out measurements on the standards as described below:

- Wipe the tubes with blue tissue or similar lint free cloth to remove condensation and finger prints.
- Insert the standard blank into the instrument with the ▼ mark facing the user. Press and hold the ON key until the display shows 0.00.
- Place each of the colour standards into the instrument with the ▼ mark facing the user and take the test reading. The reading should correspond to the calibration value within the stated tolerance as shown on the certificate.

- Water Quality Technicians record validation results on a sample label and submit label to laboratory.
- Water Quality Scientists record the result along with the standard and blank numbers and expiry date on the form *Photometer Validation Records* FM-QSC-0013.
- Check result is within the test tolerance value quoted on the Chlorometer Test Certificate.
- Only use Chlorometers that give satisfactory validation results. If unsatisfactory validation results are obtained clean sample tubes and chlorometer wells with blue tissue or similar lint free cloth and repeat test.
- If repeat test proves unsatisfactory return chlorometer to manufacturer for recalibration.
- Inform appropriate **Water Quality Scientist** if the error on chlorometer and the subsequent use of invalidated data is likely to have impacted on water quality.
- **Water Quality Scientist** will determine appropriate action.
- When complete form *Photometer Validation Records* FM-QSC-0013 is kept at local Water Quality Office, Water Distribution Depot or Water Treatment Office as appropriate to the user of the chlorometer.

7.5. Palintest 1000 Duo Chlorometer.

- Validate chlorometer as described below on a weekly basis or, if used less frequently than once a week, prior to each use.
- Water Quality Technicians are required to validate their instrument at the beginning and at the end of each day when chlorine measurements are required.
- Using certified, in date chlorometer standards (circa 0.20 and 1.00mg/l) and a blank carry out measurements on the standards as described below:

- Wipe the tubes with blue tissue or similar lint free cloth to remove condensation and finger prints.
- Insert the standard blank into the instrument with the ▼ mark on the test tube aligned with the Δ on the face of the instrument. Press and hold the ON key until the display shows 0.00.
- Place each of the colour standards into the instrument with the ▼ mark on the test tube aligned with the Δ on the face of the instrument. The reading should correspond to the calibration value within the stated tolerance as shown on the certificate.

- Water Quality Technicians record validation results on a sample label and submit label to laboratory.

- Water Quality Scientists record the result along with the standard and blank numbers and expiry date on the form *Photometer Validation Records* FM-QSC-0013.
- Check result is within the test tolerance value quoted on the Chlorometer Test Certificate.
- Only use Chlorometers that give satisfactory validation results. If unsatisfactory validation results are obtained clean sample tubes and chlorometer wells with blue tissue or similar lint free cloth and repeat test.
- If repeat test proves unsatisfactory return chlorometer to manufacturer for recalibration.
- Inform appropriate **Water Quality Scientist** if the error on chlorometer and the subsequent use of invalidated data is likely to have impacted on water quality.
- **Water Quality Scientist** will determine appropriate action.

7.6. Palintest Chlorometer (Blue).

- Validate chlorometer as described below on a weekly basis or, if used less frequently than once a week, prior to each use.
- Water Quality Technicians are required to validate their instrument at the beginning and at the end of each day when chlorine measurements are required.
- Using certified, in date chlorometer NDF Check Standards (circa 0.07mg/l (B) and 2.6mg/l (D)) and a blank carry out measurements on the standards as described below:
- NDF Check Standards take the form of coloured glass slides and care must be taken not to touch the slide to avoid contamination with finger prints.

- Press the on/off button to start the unit.
- Insert the blank standard into the machine and press the ‘blank sample’ button.
- An image displaying a blank tube will appear on the screen. When this is replaced by 0.00 the instrument is finished blanking and is ready to take a reading.
- Remove the blank standard and replace with the B standard (0.07mg/l) and press the ‘Read Sample’ button and take a reading. This reading should correspond to the calibration value shown on the Standard Certificate.
- Record readings.
- Place D standard (2.6mg/l) into machine and press the ‘Read Sample’ button and take a reading. This reading should correspond to the calibration value shown on the Standard Certificate.
- Record readings.

- Water Quality Technicians record validation results on a sample label and submit label to laboratory.
- Water Quality Scientists record the result along with the standard and blank numbers and expiry date on the form *Photometer Validation Records* FM-QSC-0013.
- Check result is within the test tolerance value quoted on the Chlorometer Test Certificate.

- Only use Chlorometers that give satisfactory validation results. If unsatisfactory validation results are obtained clean sample slides and chlorometer wells with blue tissue or similar lint free cloth and repeat test.
- If repeat test proves unsatisfactory return chlorometer to manufacturer for recalibration.
- Inform appropriate **Water Quality Scientist** if the error on chlorometer and the subsequent use of invalidated data is likely to have impacted on water quality.
- **Water Quality Scientist** will determine appropriate action.

When complete form *Photometer Validation Records* FM-QSC-0013 is kept at local Water Quality Office, Water Distribution Depot or Water Treatment Office as appropriate to the user of the chlorometer.

7.7 HACH Colorimeter II

- Any person taking chlorine readings for compliance samples must carry out a calibration check for each of those days.
- Each HACH colorimeter had a set of secondary standards. These are tested and recorded before the start and at the end of any days testing. The results are recorded on an AQC sheet (Ref FM-QSC-0012). Each AQC sheet is specific for the relevant set of standards where the parameters may vary from batch to batch. The Principal Scientist (PS) is responsible for the production of the the correct AQC forms for each set of standards.
- The results are recorded at two ranges and each range has its own upper and lower control limits.
- If any result is outside these ranges at the start of the day the sampler should attempt to exchange the HACH unit for one that is within AQC before any compliance samples are taken. If this is not possible or it is at the end of the day, all the results for that day should be highlighted as out of AQC.
- All chlorine colorimeters are calibrated annually against a set of master secondary standards held by the PS (BW). The master set of standards is checked against a chlorine primary standard.

7.8 Daily Chlorine AQC Checks

- Daily AQC checks are undertaken to check the reagents and sampler's technique. The checks are performed at the end of each sampler run and tested as per a normal free and total chlorine determination. The solution used is an AQC standard obtained from the laboratory.
- The AQC standards are logged on receipt to provide traceability of the standards.
- Results from the daily AQC checks are transferred to the associated Shewhart chart on the lab to identify any trends. Any deviations from the assigned values (i.e. results outside control range) must be reported to the PS (BW) or Deputy and investigated as per the non-conformity procedure and corrective action taken.

- The PS (BW) reviews the results monthly to ensure the performance is within specification and there are no trends or systematic errors. Each review will be signed off

by the PS (BW) or deputy. New control limits will be set each month using the previous month's data.

- Non-conformities are investigated as per the non-conformity procedure and the specific non-conformity form (Ref FM-QSM-0007).

7.9 Annual Calibration Checks

- The PS (BW) carries out an annual calibration of the colorimeters against the master colorimeter and a separate set of traceable standards.

Appendix 1

Table 1: Chlorine Calibration Chart

CHLORINE (DPD) Chlorine mg/l 520nm										
%T	9	8	7	6	5	4	3	2	1	0
90	0.01	0.02	0.04	0.05	0.06	0.07	0.08	0.1	0.11	0.12
80	0.14	0.15	0.16	0.18	0.19	0.2	0.21	0.22	0.24	0.25
70	0.26	0.27	0.29	0.3	0.32	0.33	0.35	0.36	0.38	0.4
60	0.42	0.44	0.46	0.48	0.5	0.51	0.53	0.55	0.57	0.59
50	0.61	0.63	0.65	0.68	0.7	0.72	0.74	0.76	0.78	0.8
40	0.82	0.85	0.87	0.89	0.91	0.93	0.96	0.98	1	1.03
30	1.06	1.09	1.13	1.17	1.2	1.24	1.28	1.31	1.35	1.38
20	1.42	1.46	1.51	1.56	1.64	1.7	1.77	1.84	1.92	2
10	2.08	2.16	2.24	2.32	2.4	2.5	2.6	2.72	2.84	3
0	3.2	3.4	3.7	4	4.5	5	-	-	-	-
QSC-011 On-site Determination of Chlorine										