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1 GENERAL INFORMATION

Introduction to Palintest Photometers

Thank you for purchasing this Palintest product.

Palintest instruments and reagents are renowned as being simple to use, whilst providing rapid and reliable results for the testing of water. Our instruments are of the highest quality and fully waterproof.

Palintest's experience, built-up over the last 50 years, is the reason why our instruments and reagents are used in laboratories, treatment plants, leisure facilities and industrial premises throughout the world.

Our products are packaged carefully and the product should reach you in the state it left our factory; if this product has reached you in a state that is less than satisfactory, please contact your local Palintest branch or your local distributor.

This booklet describes the best way to use Palintest products, and provides instructions for the range of water tests that can be performed using this instrument.

Palintest instruments are calibrated for Palintest reagents. To guarantee the high accuracy and performance that our instruments give, you must ensure that only Palintest reagents are used with Palintest instruments. Failure to do so can lead to erroneous results.

Kit Contents

These instructions are designed for use with the following instruments :-

- Pooltest 3
- Pooltest 6

The kits contain :-

Pooltest 3

Pooltest 3 Instrument
Instrument Instructions
Crushing Rods
Test Tube Brush
Photometer Tubes

Reagents

Chlorine (Free and Total)
pH (Phenol Red)
Cyanuric Acid

Pooltest 6

Pooltest 6 Instrument
Instrument Instructions
Crushing Rods
Test Tube Brush
Photometer Tubes

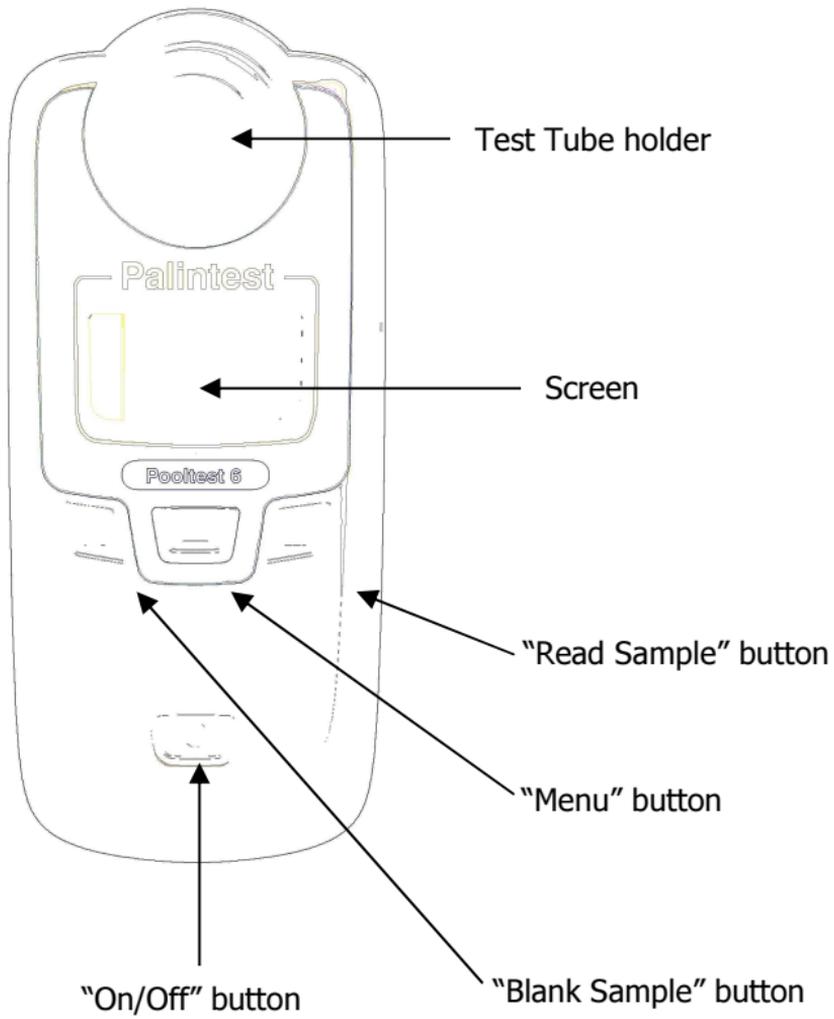
Reagents

Chlorine (Free and Total)
pH (Phenol Red)
Cyanuric Acid
Alkalinity
Calcicol
Bromine

For re-ordering codes and accessories, please see Section 6.

If you have bought the Pooltest 3 HR (High Range) or the Pooltest 6 HR (High Range) instrument/kit, please ensure you use the DPD-XF and DPD-XT reagents for measuring free and total chlorine.

Instrument Layout



2 BACKGROUND INFORMATION

Introduction to Colorimetric Measurement

Palintest tests are based on measuring the intensity of colours produced by Palintest reagents and using Palintest photometers to measure that intensity of colour. This is colorimetry and can be defined as any technique used to evaluate an unknown colour in reference to known colours.

To avoid subjective measurement between test samples and colour standards, a colorimeter can be used for quantitative measurement of the amount of coloured light absorbed by a sample (with reagents added) in reference to a untreated sample (blank).

White light is made up of many different wavelengths of light.

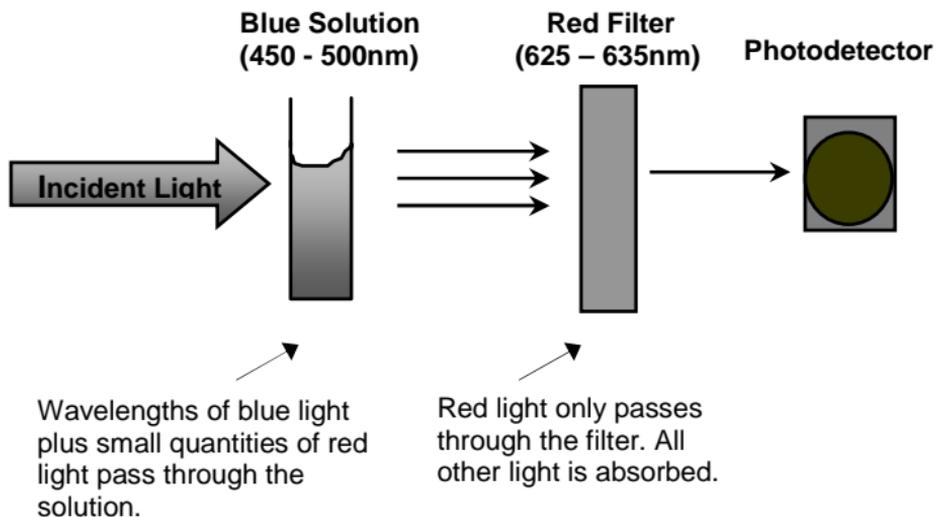
A colorimeter passes a white light beam through an optical filter which transmits only one particular band of wavelength of light to the photodetector where it is measured.

The difference in the amount of coloured light transmitted by a colourless sample (blank) and the amount of coloured light transmitted by a coloured sample is a measurement of the amount of coloured light absorbed by the sample.

The use of filters improves the sensitivity of this process and choice of the correct optical filter (and, therefore, the correct wavelength) of light is important.

It is interesting to note that the filter that gives the most sensitive calibration for a test factor is the complementary colour of the test sample. For example, the chlorine test produces a pink colour proportional to the chlorine concentration in the sample (the greater the chlorine concentration, the darker the pink colour). In this case, a green filter gives the greatest sensitivity as a pinkish-red solution absorbs mostly green light.

Palintest photometers calculate and then display the test results directly in milligrams per litre (mg/l) of the test factor, by comparing the amount of absorbed light to the calibration data programmed into the instrument.



Blanks and Samples

Palintest photometers use a BLANK tube to set the instrument to blank and a SAMPLE tube to take the reading.

A BLANK tube is a test tube filled with untreated water sample. A SAMPLE tube is a test tube containing the sample to which reagents have been added in accordance with the test procedure described.

The blank setting is held in memory. It is not necessary to reset the blank each time a reading is taken if the water samples to be tested are from the same body of water and the conditions of use are the same. The blank setting can be confirmed if necessary by taking a test reading on the blank tube.

Taking a Reading

- 1 Press the 'On/Off' button to start the unit.
- 2 Press the 'Menu' button until the test you wish to perform is indicated on the screen.
- 3 Insert your blank tube and press the 'Blank Sample' button.
- 4 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.
- 5 Remove your blank tube and replace it with the sample tube. Press the 'Read Sample' button to take a reading.
- 6 The result will be displayed on screen in mg/l.

Care and Maintenance

The handling of photometer tubes is important to ensure continuing accuracy. Scratches, finger-prints and water droplets on the tube or inside the light chamber can cause inaccurate results. It is imperative that the tubes and light chamber are clean and dry. The glassware must be clean and defect-free. Scratches and abrasions will permanently affect the accuracy of the readings. Tubes can be acid washed periodically.

Here are some hints on keeping the photometer clean, free from contamination and in good working order :-

- 1 Prepare your workplace before use. Make sure that you have enough space to work with the photometer and with the reagent systems.
- 2 Do not pour out samples or prepare the tests directly over the instrument.
- 3 Always cap the test tubes after preparing the blank and test sample.
- 4 Wipe test tubes on a clean tissue to remove drips or condensation before placing in the photometer.
- 5 Do not leave tubes standing in the photometer test chamber. Remove the tubes immediately after each test.
- 6 Immediately wipe up any drips or spillages onto the instrument or into the test chamber with a clean tissue.
- 7 Keep the instrument clean. Clean the test chamber regularly using a moistened tissue or cotton bud.

- 8 Keep the instrument in a clean, dry place when it is not in use. Keep it on a clean, dry bench away from chemicals, place it in a storage cupboard or keep it in a carrying case.

Viewing the Instrument Memory

To view the previous results (10 results are stored within the instrument memory), hold the 'menu' button down **for at least three seconds** whilst the display showing the selected test or result is on the screen.

To scroll through the 10 different results, simply press the 'menu' button. To exit the results menu, press the 'menu' button again for at least three seconds.

Backlight Operation

The backlight can be turned on and off by holding the 'On/Off' button for a two second period during power on.

3 TEST PROCEDURES

The methodologies listed here are for use with the Pooltest 3 and Pooltest 6 instruments.

Before attempting to do any tests, ensure you read 'Blanks and Samples' and the 'Care and Maintenance' sections in Section 2.

To Select the Test

Press the MENU key. The currently selected test will appear on the display :-

- Cl₂5 Chlorine
[Free and Total] (0.01 – 5 mg/l range)
- Cl₂ 10** Chlorine
[Free and Total] (0.01 – 10 mg/l range)
- pH pH (pH Units)
- CNA Cyanuric Acid
- Alk T* Alkalinity [Total]
- Calc* Calcium Hardness
- Calc NaCl* Calcium Hardness (Salt Water Pools Only)
- Br* Bromine

* = only available on the Pooltest 6 models

** = only available if you have either of the Pooltest 3 HR or the Pooltest 6 HR models

To change the test selected, press the MENU key repeatedly until the required test appears on the display.

The ranges in each test refer to the lower limit of detection to the highest value the unit can guarantee confidence up to.

Chlorine

Range

Cl₂ 5 : 0.01 – 5 mg/l

Cl₂ 10 : 0.01 – 10 mg/l

Wavelength – 530 and 575 nm

Method – DPD

Free Chlorine

- 1 Rinse test tube with sample leaving a few drops in the tube.
- 2 Crush the DPD No 1 tablet (or DPD-XF for high range instruments) in two or three drops of the water sample until the tablet is thoroughly crushed.
- 3 Add the 10 ml test solution, mix and seal the tube with the cap.
- 4 Gently invert the tube to remove any bubbles from the inner walls of the tube.
- 5 Take photometer reading.
- 6 Retain test solution if total chlorine test required (see overleaf for further instructions).

Total Chlorine

- 1 Carry out this test on the solution remaining from the Free Chlorine test.
- 2 If any non-chlorine shock treatment chemicals have been added to the pool, see additional notes below.
- 3 Add one DPD No 3 tablet (or DPD-XT for high range instruments), crush and mix to dissolve.
- 4 Stand for **two minutes**.
- 5 Take photometer reading. Ensure the display shows the test range that you desire.

To obtain COMBINED CHLORINE residual, subtract Free Chlorine result from Total Chlorine result :-
ie Combined Chlorine = Total Chlorine - Free Chlorine

For notes on chlorine testing, see overleaf.

Notes

- If any non-chlorine shock treatment chemicals have been added to the pool, add one DPD Oxystop (AP 017) tablet, crush and mix to dissolve prior to adding the DPD No 3 tablet to the test solution. Stand for one minute before proceeding. This will prevent a response caused by the shock treatment chemicals.

- DPD reacts with both chlorine and bromine. However, it is possible to determine bromine in the presence of chlorine, and to separate between bromine and chlorine residuals using a DPD methodology. For instructions on how to do this, please contact your local Palintest branch, distributor or see www.palintest.com

Reagents

AP 011 – DPD No 1 Tablets (Low Range)

AP 013 – DPD-XF Tablets (High Range)

AP 031/1 – DPD No 3 Tablets (Low Range)

AP 033/1 – DPD-XT Tablets (High Range)

AP 017 – DPD Oxystop Tablets

pH

Range: 6.5 – 8.4

Wavelength – 575 nm

Method – Phenol Red

- 1 Fill test tube with sample to the 10 ml mark.
- 2 Add one PHENOL RED tablet, crush and mix to dissolve.
- 3 Take the photometer reading.

Reagents

AP 130 - Phenol Red Tablets

Cyanuric Acid

Range: 2 – 200 mg/l

Wavelength – 530 and 575 nm

Method – Turbidity

- 1 Fill test tube with sample to the 10 ml mark.
- 2 Add one Cyanuric Acid tablet and allow to disintegrate for at least **two minutes**.
- 3 A cloudy solution indicates the presence of cyanuric acid.
- 4 Crush any remaining undissolved tablet and mix to ensure uniformity.
- 5 Take the photometer reading.

Reagents

AP 087 – Cyanuric Acid Tablets

Alkalinity (Total)

Range: 10 – 500 mg/l

Wavelength – 575 nm

Method – Acid and Indicator

- 1 Fill test tube with sample to the 10 ml mark.
- 2 Add one Alkaphot tablet, crush and mix until all the particles have dissolved. It is important to ensure that all of the tablet particles have dissolved otherwise the result may be inaccurate.
- 3 Stand for **one minute**.
- 4 Take the photometer reading. The reading represents the total alkalinity of the sample as milligrams per litre (parts per million) CaCO_3 .

Reagents

AP 188 – Alkaphot Tablets

Notes

For accurate results with Alkaphot, crush the tablet very thoroughly, stand for one minute and then remix the solution. Look carefully at the bottom of the tube. If a thin yellow layer forms, then mix the tube again. This ensures that reaction is complete. The result should not change on standing.

Calcium Hardness

Range: 5 – 500 mg/l

Wavelength – 575 nm

Method – Indicator

- 1 Fill test tube with sample to the 10 ml mark.
- 2 Add one Calcicol No 1 tablet, crush and mix to dissolve.
- 3 Add one Calcicol No 2 tablet, crush and mix to dissolve.
- 4 Stand for **two minutes**.
- 5 Take the photometer reading.

Reagents

AP 252 – Calcicol No 1 and No 2 Tablets

Notes

- The Calc NaCl setting is for salt pools only. This requires a different calibration but the method outlined for the standard Calcicol test is still valid.
- Magnesium hardness (up to 200 mg/l as CaCO_3) does not interfere with the test.
- Iron at levels above 10 mg/l may cause low results. Zinc above 5 mg/l may cause high results.

Bromine

Range: 0.02 – 10 mg/l

Wavelength – 530 nm

Method – DPD

- 1 Rinse test tube with sample leaving a few drops of sample in the tube.
- 2 Crush the DPD No 1 tablet in two or three drops of the water sample until the tablet is thoroughly crushed.
- 3 Add the 10 ml test solution, mix and seal the tube with the cap.
- 4 Gently invert the tube to remove any bubbles from the inner walls of the tube
- 5 Take the photometer reading.

Reagents

AP 011 – DPD No 1 Tablets

4 INSTRUMENT

For an illustration on the instrument layout, see Section 1.

For information on performing a test, see Section 2.

Replacing the Batteries

Replace the battery when the  symbol remains on the display. Use 2 x 1.5v alkaline 'AA' batteries, MN 1500, LR6, E91, AM3 or equivalent. Remove batteries from instrument if it is to be stored or left unused for a long period of time.

Liability

Under no circumstances shall Palintest Ltd be liable for loss of life, property, profits or other damages incurred through the use or misuse of their products.

Disposal

Waste Electrical and Electronic Equipment (WEEE).

Natural resources were used in the production of this equipment. This equipment may contain materials that are hazardous to health and the environment.

To avoid harm to the environment and natural resources, the use of appropriate recycling systems is recommended. The crossed out wheeled bin symbol on the meter encourages you to use these systems when disposing of this equipment.

Error Messages

The photometer will display an error message in the unlikely event of malfunction. These error messages are mainly designed to assist service staff in diagnosing instrument faults. In the event of an error message appearing on the photometer display, contact your local Palintest Technical Services Department or your local distributor.

Error messages are coded 7, 8 and 9 and all relate to blanking the instrument. In the first instance, the user should check the operating technique and sample clarity. If these are in order, then these errors indicate a fault in the optics :-

Error 7 indicates too much light – remove the instrument from bright light.

Error 8 indicates a fault with one of the optics components, and requires service assistance.

Error 9 indicates not enough light – follow 'Cleaning the Optics' routine.

If the problem persists, contact your local Palintest branch or distributor.

Technical Specification

Instrument	Dual wavelength, direct-reading colorimeter
Optics	Palintest dual LED light source optical system with narrow band wavelength filters and photodetectors
Wavelengths	Automatic wavelength selection of :- 530 and 575nm
Wavelength Tolerance	$\pm 2\text{nm}$
Filter Bandwidth	10nm
LCD Display	128 x 64 pixel screen
Instrument Operating Temperature Range	0 – 50°C
Waterproof Rating	IP 67
Test Cells	25 mm diameter tubes
Blank/Zero setting	Held in memory or reset for each reading
Power Supply	2 x 1.5V 'AA' batteries - auto switch-off setting
Size	150 x 65 x 42 mm
Weight	200g (including batteries)

Cleaning the Optics

Any build-up of dirt or deposits may interrupt light transmission and affect readings.

To clean the optics gently clean the internal surfaces of the optics with a soft, non-abrasive cloth. Do not use solvents. Deposits may be removed with a slightly dampened cotton bud.

The photometer is fitted with long-life light sources and contains no user-serviceable components. If the instrument requires servicing or repair, this can be arranged through our Technical Services Department.

Servicing and Warranty

Palintest Pooltest Photometers are guaranteed for a period of two years from the date of purchase, excluding accidental damage or damage caused by unauthorised repair or misuse. Should repair be necessary, contact our Technical Services Department quoting the serial number. This guarantee does not affect your statutory rights.

An instrument failure due to test cell contamination is not covered by the Palintest instrument warranty.

5 TROUBLESHOOTING

Chemistry Troubleshooting

It is very important to specify Palintest Photometer Grade tablets when ordering replacement reagents for this instrument. Using an alternative grade of tablet may lead to a turbid sample which in turn leads to inaccurate results.

Chlorine:

Note that a too high chlorine level (>8 mg/l) can cause bleaching of the pink coloration formed in the DPD test and give a false negative or low result (this does not occur with DPD-XF and XT reagents). If a colourless or weakly coloured test solution is obtained when chlorine is known to be present, check for the possibility of bleaching by repeating the test on a sample diluted with chlorine-free water.

Very high levels of calcium hardness (>1000 mg/l as CaCO₃) may lead to turbidity when performing the test. If this occurs, you need to add one EDTA (AT 090) tablet to your sample prior to adding your DPD tablet.

Non-chlorine shock dosing treatments for swimming pools are widely used to support chlorine treated pools. Chemicals containing monopotassium persulphate (MPS) are used to oxidise organic contaminants in the water and regenerate free chlorine from chloramines.

Typical products are Oxybrite, Oxysure and Purolyte Plus.

Excess MPS reacts in the DPD test. It does not affect the free chlorine result with DPD No 1, but raises the DPD No 3 reading, thus yielding a false high result for combined chlorine. Unwary pool operators may add further shock dose at this point, and this further raises the false total chlorine result. Palintest's DPD Oxystop has been developed to prevent this problem.

The DPD Oxystop tablet should be added after the DPD No 1 Free Chlorine test result has been read and before the DPD No 3 tablet is added. The tablet must be thoroughly crushed and mixed well into the solution, and allowed a one-minute stand before proceeding with the DPD No 3 tablet.

Thus, Oxystop suppresses the response from MPS and allow accurate measurements of free and total chlorine on non-chlorine shock dosed pool waters.

The DPD Oxystop tablet may also be used in exactly the same way with the DPD-XF and DPD-XT tablets.

pH:

Ionic strength, temperature and other water factors will have an effect on pH readings. This test has been calibrated for conditions most likely to be encountered in a typical swimming pool.

The colour range of the phenol red test is yellow, through orange, to red. The formation of an intense purple coloration shows that the indicator has been affected by high chlorine or bromine residuals. In such cases the result should be disregarded.

Cyanuric Acid:

The range of the cyanuric acid (CNA) test is 2 - 200 mg/l. Higher levels can be tested by first diluting the sample with mains or deionised water and then applying the appropriate dilution factor. Palintest's Dilution Tube (PT 512), which is available as an optional extra, should be used for the dilution.

Calcium Hardness:

The expression of hardness results sometimes causes confusion. It is normal practice to express the results of hardness tests as mg/l CaCO_3 (calcium carbonate). This is merely a convention to allow the comparison of different results and does not necessarily indicate that the hardness is present in the water in this form.

Results may also be expressed in literature as mg/l Ca. The instrument will not do this calculation automatically but to convert mg/l CaCO_3 to mg/l Ca multiply by 0.4.

Bromine:

For most purposes it is sufficient to simply measure the total bromine residual (using DPD No 1 tablets) since both free and combined bromine are active disinfectants.

Note that a too high bromine level (above 20 mg/l) can cause bleaching of the pink colouration formed in the DPD test and give a false negative or low result. If a colourless or weakly coloured test solution is obtained when bromine is known to be present, check for the possibility of bleaching by repeating the test on a sample diluted with bromine/chlorine-free water.

Water Balance:

In swimming pools, the effects of the pH, hardness and alkalinity are all inter-related. The likelihood of corrosive or scale problems can be predicted using the Palintest Water Balance Calculation. The resulting value indicates to users the corrosion or scale forming tendency of the water. The Palintest method is a simplified version of the Langelier Index and this can be calculated from the Palintest result by subtracting 11.1.

Calculation:

- 1 Take a sample of the water and measure the calcium hardness. Using the table overleaf, read off the factor which corresponds nearest to the calcium hardness value measured. Record this Calcium Hardness Factor (Line 1).

- 2 Take a sample of the water and measure the total alkalinity. Using the table below, read off the factor which corresponds nearest to the total alkalinity value measured. Record this Total Alkalinity Factor (Line 2).
- 3 Take a sample of the water and measure the pH. Record the actual pH value (Line 3).
- 4 Add together the values of lines 1, 2 and 3. This gives the Palintest Balanced Water Index for the water. Compare the index obtained with the Water Balance Condition Table overleaf. This table indicates whether the water is in balance, and if not, the recommended action to be taken :-

Calcium Hardness/Alkalinity as mg/l CaCO₃	Factor	Calcium Hardness/Alkalinity as mg/l CaCO₃	Factor
20	1.0	200	2.0
30	1.2	250	2.1
40	1.3	300	2.2
50	1.4	350	2.25
66	1.5	400	2.3
80	1.6	500	2.4
90	1.65	550	2.45
100	1.7	600	2.5
125	1.8	700	2.55
150	1.9	800	2.6

5 Calculation:

Line 1 Calcium Hardness Factor

Line 2 + Alkalinity Factor

Line 3 + actual pH

Sum =

Index	Water Balance Condition	Recommendation
Below 9.6	Highly Corrosive	Increase pH to 7.5 - 7.8. Increase Calcium Hardness to at least 50 mg/l. Increase Total Alkalinity to 100 mg/l or higher as necessary. Retest Water Balance.
9.6 - 10.5	Corrosive	
10.6 - 10.9	Acceptable Balance	Retest water regularly.
11.0 - 11.2	Ideal Balance	No action required.
11.3 - 11.6	Acceptable Balance	Retest water regularly.
11.7 - 12.6	Scale Forming	Decrease pH to 7.2 - 7.5. Decrease Total Alkalinity to 150 mg/l or lower as necessary. Retest Water Balance.
Above 12.6	Highly Scale Forming	

Notes

- 1 The test has been calculated for an average heated swimming pool (82°F, 28°C). For unheated swimming pools, subtract 0.1 from the index value obtained, for high temperature pools and spas, add 0.1 to the index value obtained.
- 2 Always keep the pH, Total Alkalinity and Calcium Hardness levels within the limits recommended in pool operating instructions and chemical suppliers' recommendations. Seek specialist advice if corrosion or scale formation is still apparent even though the water is shown to be in a balanced condition.

Compliance

The DPD method is a published standard method in the UK, the European Community, USA, Australia and in many other countries. The Palintest DPD free and total chlorine tests are approved by the USEPA as accepted versions of the Standard Method 4500-C1-G (0 – 5 mg/l).

The Palintest photometer series has been independently tested and has earned the European CE Mark of Compliance for electro-magnetic compatibility (EMC).

Sample Dilution and Collection

When the test result is outside the concentration range of the test, the photometer will display the '>' symbol. In such cases it is necessary to dilute the pool water and repeat the test. A Palintest dilution tube (PT 512) is available to dilute samples accurately.

If the result is close to the top of the scale (eg chlorine above 4 mg/l on the Chlorine-Free/5 or Chlorine-Total/5 range, calcium hardness above 300 mg/l and cyanuric acid above 150 mg/l) and a more accurate result is required, a dilution may be used to increase the sensitivity of the test.

The following points should be observed when taking water samples from the pool. Take pool water samples from below the water surface. Collect in a clean plastic bottle and fill to the neck so as to avoid unnecessary airspace.

The free chlorine or bromine may drop during sample storage. Other parameters such as pH and alkalinity can also change. Samples should therefore be tested as soon as possible after sample collection.

6 REORDER CODES and ACCESSORIES

Reagent Description	Product Code	
	50 Tests	250 Tests
DPD No 1 Tablet Pack	PM 011	AP 011
DPD-XF Tablet Pack	PM 013	AP 013
DPD No 3 Tablet Pack	PM 031/1	AP 031/1
DPD-XT Tablet Pack	PM 033/1	AP 033/1
Phenol Red	PM 130	AP 130
Cyanuric Acid	PM 087	AP 087
Alkaphot [®]	PM 188	AP 188
Calcicol [®]	PM 252	AP 252
EDTA Tablets	-	AT 090
DPD Oxystop	-	AP 017

Accessories Description	Product Code
Test Tube Brush	PT 663
Replacement Photometer Tubes (x5)	PT 555
Photometer Tube Rack	PT 545
Crushing Rods (x10)	PT 502
Pooltest Check Standards	SPC 006