The Palintest® System

Instructions

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Palintest®

TABLET COUNT TESTS AND OTHER METHODS

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The Palintest® System

Water testing plays a vital role in our modern society. Moves to improve drinking water quality, heightened environmental concerns and increased use of water for industry and leisure; all create the need for quick accurate water test results.

In each and every case the Palintest system provides the answer. Simple to use test equipment, and reagents in stable tablet form, mean that rapid reliable results can be obtained by all users - with or without formal laboratory training.

This is why the Palintest system is used in laboratories, treatment plants, leisure facilities and industrial premises throughout the world - you can rely on 25 years of Palintest experience for your water testing needs.

Palintest®

Tablet Count Tests and Other Methods

Palintest Tablet Count tests provide an extremely simple method of analysis for an important range of water parameters. The tests are particularly useful for the routine control of industrial waters such as boiler waters and cooling water systems, as well as swimming pools, natural waters and similar applications.

Palintest tablet count tests are extremely simple to perform. The tests are carried out by taking a measured volume of water and adding tablets one at a time until a prescribed colour change takes place. The result of the test is given by the number of tablets used in relation to the volume of water sample taken. A wide range of test concentrations can be measured by varying the sample size taken of the test.

The following pages describe the Palintest Tablet Count method and give instructions for the wide range of water tests that can be performed using this method.

The Palintest system of analysis includes a number of tests based on miscellaneous methods of analysis. These tests include turbidity methods using a special double tube assembly, microtitration procedures and multiple tube techniques. For convenience, test procedures for these other tests are included in this section.

Tablet Count/Other Test Instructions

Booklets supplied with test kits may contain only the relevent test instruction sheets. Additional sheets describing other tests, test equipment or instruments may also be included.

Tablet Count Tests

Instructions for using Palintest Tablet Count Method of Water Analysis

The Palintest Tablet Count method provides an extremely easy means of analysis for an important range of water parameters. The tests are carried out simply by taking a measured volume of water and adding tablets one at a time until a prescribed colour change takes place. The result of the test is given by the number of tablets used in relation to the volume of water taken.

Test Reagents

The test tablets used in tablet count procedures contain accurately standardized titration reagents combined with specific colour indicators. In certain tests a conditioning tablet is first used to provide the correct conditions for the test. Test instructions for the individual tests indicate the test reagents required and the method of use.

Equipment Needed

The only equipment needed to carry out tablet count tests is a suitable container for the water sample. Palintest Tablet Count tests are variously based on a 10ml, 50ml, 100ml or 200ml sample size. The following sample containers are available for carrying out tablet count tests:

PT 505 Sample Container 200/100/50 ml, glass bottle
PT 510 Sample Container 100/50/1 Oml, plastic tube
PT 506 Sample Container 50/10ml, plastic tube
PT 519 Sample Container 50/10ml, plastic bottle

PT 218 Tablet Count Module. Contains one PT 510 Sample Container 100/50/10ml and one PT 369 Measuring Syringe 10ml. The latter enables small samples to be measured out accurately.

Test Range/Sample Size

In tablet count tests, the test range depends on the sample size taken. The larger the sample size, the lower the concentration that can be measured. Similarly the smaller the sample size, the higher the test range. The sample sizes recommended in individual test instructions are those which are most appropriate to the test ranges likely to be encountered in practice.

The maximum concentration that can be measured for each sample size is governed by the number of tablets which can be conveniently added to the water sample. The most accurate result is achieved when a tablet count of between four and twelve tablets is obtained. When the tablet count falls outside this number it is recommended that a larger or smaller sample be taken as appropriate to bring the tablet count within this range.

When using small samples of 10ml or less it is desirable, once the sample has been measured out, to increase the working volume of the solution by adding deionised water (approximately 40ml) to the sample container. This is merely to aid the dissolving of the tablets and observation of the colour change. It does not effect the calculation of the test result.

Calculation of Result

The test result depends on the number of count tablets used in relation to the sample size taken. Individual test instructions give the method of calculating the test result for different sample sizes for that test.

Palintest
Test Instructions

ALKALINITY M and P

Tablet Count Method
0 - 1000 mg/l

Test for Alkalinity M, P and Caustic in Boiler Water and Other Industrial Waters

The Alkalinity of water is caused by the presence of alkaline substances such as hydroxides, carbonates, bicarbonates and, to a lesser extent, silicates and phosphates. Quantitatively alkalinity is the capacity of the water to react with acid to a specified pH end point. The value obtained will depend on the pH indicator used. Two measures of alkalinity are conventionally applied - Alkaphot M (Alkalinity to methyl orange) and Alkaphot P (Alkalinity to phenolphthalein).

Alkalinity is an important test parameter in a number of industrial water uses, notably in boiler water treatment. Boilers and steam plants are normally operated under conditions of high alkalinity in order to minimize corrosion and the monitoring of alkalinity is an important control test.

The Palintest Alkalinity M and Alkalinity P tests provide a simple means of checking alkalinity levels over the range 0 - 1000 mg/l $CaCO_3$. The tests are particularly suited to boiler and industrial waters. A variant of the Alkalinity P test is used to determine caustic (hydroxide) alkalinity. The alkalinities specifically due to carbonates, bicarbonates and hydroxides can be calculated from the various data obtained.

Method

The Palintest Alkalinity M and Alkalinity P tests are each based on the use of a single tablet reagent containing a precisely standardised amount of acid combined with the appropriate colour indicator. The tests are carried out simply by adding the reagent tablets one at a time to a sample of the water until the appropriate colour change takes place.

For the measurement of Caustic Alkalinity, also known as hydroxide alkalinity, the Alkalinity P tablets are used in conjunction with a supplementary tablet containing barium chloride. The latter precipitates carbonates and the test then responds to the hydroxides only.

Reagents and Equipment

Palintest Alkalinity M tablets
Palintest Alkalinity P tablets
Palintest Sample Container 100/50/10 ml plastic (PT 510) or
Palintest Sample Container 200/100/50 ml glass (PT 505)

Test Range

The tests may be carried out on a 50 ml, 100 ml or 200 ml sample, depending on the range of alkalinity under test. The table below indicates the sample size appropriate to various alkalinity test ranges.

Test Range	**Sample Size**
0 - 250 mg/l $CaCO_3$	200 ml
0 - 500 mg/l $CaCO_3$	100 ml
0 - 1000 mg/l $CaCO_3$	50 ml

Alkalinity M

1. Select the sample size appropriate to the Alkalinity M range under test. Take a sample of the correct size in the Palintest sample container.

2. Add one Alkalinity M tablet and shake the container until the tablet disintegrates.

3. Continue adding tablets one at a time in this manner until the colour of the solution changes from yellow to bright red. (Ignore any intermediate orange-pink colouration).

4. Note the number of tablets used and calculate the result from the formula below appropriate to the sample volume taken.

Sample Size	Calculation Alkalinity M (mg/l mg/l $CaCO_3$)
200 ml	= (No. of Tablets x 20) - 10
100 ml	= (No. of Tablets x 40) - 20
50 ml	= (No. of Tablets x 80) - 40

Alkalinity P

Select the sample size appropriate to the Alkalinity P range under test. Take a sample of the correct size in the Palintest sample container.

1. Add one Alkalinity P tablet and shake the container until the tablet disintegrates.

2. Continue adding tablets one at a time in this manner until the colour of the solution changes from blue to yellow.

3. Note the number of tablets used and calculate the result from the formula below appropriate to the sample volume taken.

Sample Size	Calculation Alkalinity P (mg/l mg/l $CaCO_3$)
200 ml	= (No. of Tablets x 20) - 10
100 ml	= (No. of Tablets x 40) - 20
50 ml	= (No. of Tablets x 80) - 40

Caustic Alkalinity

1. Select the sample size appropriate to the Caustic Alkalinity range under test. Take a sample of the correct size in the Palintest sample container.

2. Add one Alkalinity P ($BaCl_2$) tablet per 50 ml of sample taken. I.e. for a 50 ml sample add one tablet, for a 200 ml sample add four tablets. Shake the container until the tablet disintegrates. A blue colour indicates the presence of Caustic Alkalinity.

3. Add one Alkalinity P tablet and shake the container until all the tablet disintegrates.

4. Continue adding Alkalinity P tablets, one at a time in this manner, until the colour of the solution changes from blue to yellow.

5. Note the number of tablets used and calculate the result from the formula below appropriate to the sample volume taken.

Sample Size	Calculation Caustic Alkalinity (mg/l mg/l $CaCO_3$)
200 ml	= (No. of Tablets x 20) - 10
100 ml	= (No. of Tablets x 40) - 20
50 ml	= (No. of Tablets x 80) - 40

CAUTION: ALKALINITY P ($BaCl_2$) TABLETS ARE HARMFUL IF INGESTED. EACH TABLET CONTAINS 450 mg BARIUM CHLORIDE. AVOID HANDING TABLETS AND WASH HANDS AFTER USE.

Alkalinity Relationships

From the results obtained from the foregoing alkalinity measurements, it is possible to classify the sample into the three main chemical forms of alkalinity present in most waters, namely hydroxides, carbonates and bicarbonates. This calculated relationship assumes the absence of other weak forms of alkalinity and also assumes that hydroxides and bicarbonates are not compatible in the same sample. The chemical forms of alkalinity, expressed as mg/l $CaCO_3$, are calculated by the following equations.

Hydroxide = C
Carbonate = 2P - 2C
Bicarbonate = M - 2P

Where, C, P and M are the results of the Caustic Alkalinity, Alkalinity P and Alkalinity M tests respectively. Note that bicarbonate is only present if M is greater than 2P.

NOTE

The expression of alkalinity results sometimes causes confusion. It is normal practice to express the result 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 alkalinity is present in the water in this form. The different chemical forms of alkalinity have been referred to in the test instructions.

Palintest
Test Instructions

CALCIUM HARDNESS

Tablet Count Method
0 - 500 mg/l

Test for Calcium Hardness in Natural and Treated Water

Calcium hardness is caused by the presence of calcium ions in the water. Calcium salts can be readily precipitated from water and high levels of calcium hardness tend to promote scale formation in water systems, such as, boilers and steam plants; and for swimming pool waters.

The Palintest Calcium Hardness test provides a simple method of determining calcium hardness over the range 0 - 500 mg/l $CaCO_3$.

Method

Calcium salts are complexed by reaction with ethylenediaminetetraacetic acid (EDTA). Excess calcium ions react with a specific indicator to form a distinctive colouration. The test is carried out in alkaline solution in order to precipitate magnesium salts which would otherwise interfere with the test. The Palintest Calcium Hardness test uses a tablet reagent containing a standardised amount of EDTA in alkaline formulation with murexide as indicator. The test is carried out by adding tablets, one at a time, to a sample of water until the colour changes from pink to violet. The result is calculated from the number of tablets used in relation to the volume of water taken.

Reagents and Equipment

Palintest Calcium Hardness tablets
Palintest Sample Container, 50/10 ml plastic (PT 506, PT 519) or
Palintest Sample Container 100/50/10 ml plastic (PT 510) or
Palintest Sample Container 200/100/50 ml glass (PT 505)

Test Range

The test is normally carried out on a 50 ml sample, although a larger sample may be used if a lower test range is required.. The table below indicates the sample size appropriate to various calcium hardness test ranges.

Test Range	Sample Size
0 - 100 mg/l	200 ml
0 - 250 mg/l	100 ml
0 - 500 mg/l	50 ml

TEST PROCEDURE

1. Select the sample size appropriate to the calcium hardness range under test. Take a sample of the correct size in the Palintest sample container.

2. Add one Calcium Hardness tablet and shake the container until the tablet disintegrates.

3. Continue adding tablets one at a time in this manner until the colour of the solution changes from pink to violet.

4. Note the number of tablets used and calculate the result from the formula below appropriate to the sample volume taken.

Sample Size	Calculation Calcium Hardness (mg/l $CaCO_3$)
200 ml	= (No. of Tablets x 10) -5
100 ml	= (No. of Tablets x 20) - 10
50 ml	= (No. of Tablets x 40) - 20

Magnesium Hardness

Magnesium Hardness is caused by the presence of magnesium salts in the water. The total hardness of the water is the sum of the calcium hardness and magnesium hardness. Total hardness of the water may be determined using the Palintest Hardness method (see test instruction sheet H1). If required the magnesium hardness can therefore be obtained by the difference between total hardness and calcium hardness test results:

Magnesium Hardness (as $CaCO_3$) = Total Hardness - Calcium Hardness

NOTE

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) irrespective of whether total, calcium or magnesium hardness is being measured. 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.

Palintest
Test Instructions

CYANURIC ACID

Turbidity Method
0 - 200 mg/l

Test for Cyanuric Acid in Swimming Pool Water

Cyanuric acid is extensively used as a chlorine stabilizer in swimming pool water. Cyanuric acid itself may be added to the water when the pool is first filled, or may be introduced gradually through the use of chloroisocyanurate based chlorine donors. Swimming pool water treatment instructions in the United Kingdom generally recommend a cyanuric acid level within the range 30 - 200 mg/l. The Palintest Cyanuric Acid test can be used to measure the cyanuric acid level over the ranges 0 - 100 mg/l and 0 - 200 mg/l.

Method

The Palintest Cyanuric Acid test is based on a single tablet reagent containing melamine and a buffer. Cyanuric acid reacts with melamine in buffered solution to form an insoluble complex. At the cyanuric acid levels encountered in pool water, this is observed as turbidity in the test sample. The degree of turbidity is proportional to the cyanuric acid concentration and is measured using a special double tube assembly.

Reagents and Equipment

Palintest Cyanuric Acid tablets
Palintest Double Tube Assembly (PT 509)

TEST PROCEDURE

1. Separate the tubes of the double tube assembly and fill the round outer tube to the top line with pool water..

2. Add one Cyanuric Acid tablet and allow to disintegrate. A cloudy solution indicates the presence of cyanuric acid.

3. Insert the square graduated inner tube into the outer tube the, viewing from the top, move the inner tube up and down until the black spot at the bottom is just no longer visible.

4. Read the graduation mark on the inner tube level with the top of the solution in the tubes. This figure represents the cyanuric acid concentration present in the pool water as milligrams per litre.

If the solution is too cloudy to obtain a reading, repeat the test filling the outer tube to the bottom line only and making up to the toe line with tap or distilled water. Continue the test in the manner described above but multiply the tube reading obtained by 2. This gives the cyanuric acid concentration in the original sample. If the solution is still too cloudy further dilutions of the water sample should be made and the tube reading multiplied by the appropriate factor.

Palintest
Test Instructions

CHLORIDE

Test for Chloride in Natural and Treated Water

Tablet Count Method
0 - 50 mg/l Cl to
0 - 25,000 mg/l Cl

The Palintest Chloride method provides a simple method for measuring chloride salt levels. There are many applications in water technology that require determination of chlorides. These include the measurement of low levels of chloride to determine the extent of carry-over in boiler condensates; chloride determination to assess salt build-up in swimming pools or boiler waters; and measurement of high chloride levels for testing sea water or determining the saltiness of brackish waters. A further application is for checking swimming pools where salt has been artificially added to simulate sea water bathing, or where this is necessary for the operation of certain types of electrolytic hypochlorite generator.

The test can be used for measuring these widely different chloride concentrations by varying the sample size selected. The results of the tests are expressed in terms of chloride ion (Cl^-), but may be converted to concentrations in terms of sodium chloride (NaCl) by applying a factor.

Method

Chlorides react with silver nitrate to produce insoluble silver chloride, excess silver ions react with potassium chromate to produce a red-brown colouration. The Palintest chloride test uses a tablet reagent containing a standardized amount of silver nitrate and potassium chromate as indicator. The test is carried out by adding tablets, one at a time, to a sample of water until the colour changes from yellow to brown. The result is calculated from the number of tablets used in relation to the volume of water sample taken.

Reagents and Equipment

Palintest Chloride tablets
Palintest Sample Container, 50/10 ml plastic (PT 506, PT 519) or
Palintest Sample Container 100/50/10 ml plastic (PT 510) or
Palintest Sample Container 200/100/50 ml glass (PT 505)
Palintest Measuring Syringe, 2 ml (PT 362)

The last item of equipment is optional and is only required for high range tests where small sample sizes are to be taken.

Test Range

The table below indicates the test range and sample size appropriate to various practical applications for chloride testing..

Test Range	Sample Size	Application
0 - 50 mg/l Cl	200 ml	Boiler Condensate
0 - 250 mg/l Cl	50 ml	Natural Water, Drinking Water
0 - 1000 mg/l Cl	10 ml	Swimming Pool Water, Boiler Water
0 - 5000 mg/l Cl	2 ml	Swimming Pool Water (with salt artificially added)
0 - 25,000 mg/l Cl	0.5 ml	Sea Water, Brackish Water

TEST PROCEDURE

1. Select the sample size appropriate to the test application using the above table. Take a sample of the appropriate size in the Palintest sample container.

   For small sample sizes use the measuring tube or dropping pipette and transfer the sample to the Palintest sample container. Make up the volume to approximately 10 ml using distilled water.

2. Add one Chloride tablet and shake the container until the tablet disintegrates.

3. Continue adding tablets one at a time in this manner until the colour of the solution changes from yellow to brown.

4. Note the number of tablets used and calculate the result from the formula below appropriate to the sample volume taken.

Sample Size	Calculation Calcium Hardness (mg/l $CaCO_3$)
200 ml	= (No. of Tablets - 1) x 5
50 ml	= (No. of Tablets - 1) x 20
10 ml	= (No. of Tablets - 1) x 100
2 ml	= (No. of Tablets - 1) x 500
0.5 ml	= (No. of Tablets - 1) x 2000

To convert Chloride ion (Cl^-) to Sodium Chloride (NaCl) multiply the result by 1.64.

NOTE

When testing sea water or other strong chloride solution, it may be more convenient to express the concentrations as parts per thousand or as a percentage.

To convert milligrams per litre (mg/l) to parts per thousand (ppt) divide the result by 1000.

To convert milligrams per litre (mg/l) to percentage concentration (%) divide the result by 10,000.

Palintest
Test Instructions

CLEANING ACID STRENGTH

Tablet Count Method

Test for the Strength of Industrial Cleaning and Descaling Acids

0 - 10%

Dilute acids are commonly used in a variety of industrial plant cleaning and descaling operations, and in other industrial applications. It is normally necessary to check the acid strength at the start, during and at the end of such operations. The Palintest Cleaning Acid Strength test provides a quick and simple method of determining acid strength in these applications.

The Palintest Cleaning Acid Strength test is calibrated for use with sulphamic, sulphuric, hydrochloric, phosphoric, acetic and citric acids. The test range is approximately 0 - 10% depending on the acid in use.

Method

The test uses a tablet reagent containing a standardized amount of alkali together with a colour indicator. The test is carried out by adding tablets, one at a time, to a sample of the dilute acid until a colour change occurs. The result is calculated from the number of tablets used in the test.

Reagents and Equipment

Palintest Cleaning Acid Strength tablets
Palintest Sample Container 100/50/10 ml plastic (PT 510)

Palintest Cleaning Acid Strength Test Kit CS 133 is a complete kit supplied with a sample container and sufficient tablets for approximately 20 tests.

TEST PROCEDURE

1. Take a 10 ml sample of the dilute acid under test in the Palintest sample container.

2. Dilute the sample by making up to the 50 ml mark with deionised or tap water.

3. Add one Cleaning Acid Strength tablet and allow the tablet to dissolve. The tablets produce considerable effervescence. DO NOT STOPPER OR SEAL THE CONTAINER. DO NOT SHAKE THE CONTAINER VIGOROUSLY.

4. Continue adding tablets one at a time in this manner until the red colour disappears. Note the number of tablets used.

5. To calculate the acid strength as percentage acid, multiply the number of tablets used by the factor below appropriate to the acid in use.

Sulphamic Acid	x 2.0
Acetic Acid	x 1.25
Sulphuric Acid	x 1.0
Hydrochloric Acid	x 0.75
Phosphoric Acid	x 2.0
Citric Acid	x 1.6

Example: *If using hydrochloric acid solution, the test requires six tablets then the hydrochloric acid strength is 6 x 0.75 = 4.5%*

CAUTION

Care must be exercised at all times when handling industrial acids. This kit should only be used by personnel skilled in handling these acids and who should wear all normal protective clothing during use. The kit is for testing dilute acids only.

Palintest Cleaning Acid Strength tablets are highly effervescent. Do not stopper the sample container or shake the container vigorously during the tablet addition. The carbon dioxide gas given off from the tablets must be allowed to escape to prevent pressure build up.

Palintest
Test Instructions

HARDNESS

Tablet Count Method

Test for Hardness in Natural and Treated Water

0 - 500 mg/l $CaCO_3$

Water hardness is caused by the presence of calcium and magnesium salts. High levels of hardness prevent the formation of lather with soap, and can cuase scaling in water systems. This is particularly true in boilers and steam plants. Hardness is an important control test in a wide variety of applications.

The Palintest Hardness test provides a simple method of checking water hardness over the range 0 - 500 mg/l $CaCO_3$.

Method

Calcium and magnesium ions are complexed by reaction with ethylenediaminetetraacetic acid (EDTA). Excess calcium and magnesium ions react with a specific indicator to form a distinctive colouration. The Palintest Hardness test uses a tablet reagent containing a standardised amount of EDTA eith eriochrome black as indicator. The test is carried out by adding tablets, one at a time, to a sample of water until the colour changes from plum red to blue. The result is calculated from the number of tablets used in relation to the volume of water sample taken.

Reagents and Equipment

Palintest Hardness tablets
Palintest Sample Container, 50/10 ml plastic (PT 506, PT 519) or
Palintest Sample Container 100/50/10 ml plastic (PT 510) or
Palintest Sample Container 200/100/50 ml glass (PT 505)

Test Range

The test is normally carried out on a 50 ml sample, although a larger sample may be used if a lower test range is required.. The table below indicates the sample size appropriate to various hardness test ranges.

Test Range	Sample Size
0 - 100 mg/l $CaCO_3$	200 ml
0 - 250 mg/l $CaCO_3$	100 ml
0 - 500 mg/l $CaCO_3$	50 ml

TEST PROCEDURE

1. Select the sample size appropriate to the hardness range under test. Take a sample of the correct size in the Palintest sample container.

2. Add one Hardness tablet and shake the container until the tablet disintegrates.

3. Continue adding tablets one at a time in this manner until the colour of the solution changes from plum red to blue..
4. Note the number of tablets used and calculate the result from the formula below appropriate to the sample volume taken.

Sample Size	Calculation Hardness (mg/l $CaCO_3$)
200 ml	= (No. of Tablets x 10) -5
100 ml	= (No. of Tablets x 20) - 10
50 ml	= (No. of Tablets x 40) - 20

NOTES

1. 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.

2. This test measures total hardness, ie the total content of calcium and magnesium ions in the water. For the specific measurement of calcium hardness and magnesium hardness, refer to the Palintest Calcium Hardness Test.

3. For the measurement of low levels of hardness in softened waters, use the Palintest Hardness LR or Palintest Hardness VLR tests.

Palintest
Test Instructions

HARDNESS LR

Tablet Count Method

Test for Low Levels of Hardness in Soft and Softened Waters

0 - 50 mg/l $CaCO_3$

Water hardness can cause problems in boilers and steam plants, in certain industrial processes and in industrial water systems. Ion-exchange water softeners are widely used for the removal of water hardness. It is often desirable to test the softened water to ensure that the correct degree of hardness removal has taken place.

The Palintest Hardness LR test provides a simple method of checking low levels of water hardness over the range 0 - 50 mg/l $CaCO_3$.

Method

Calcium and magnesium ions, which cause water hardness, are complexed by reaction with ethylenediaminetetraacetic acid (EDTA). Excess calcium and magnesium ions react with a specific indicator to form a distinctive colouration. The Palintest Hardness LR test uses a tablet reagent containing a standardised amount of EDTA with Eriochrome black as indicator. The test is carried out by adding tablets, one at a time, to a sample of water until the colour changes from plum red to blue. The result is calculated from the number of tablets used in relation to the volume of water sample taken.

Reagents and Equipment

Palintest Hardness LR Tablets
Palintest Sample Container, 50/10 ml plastic (PT 506, PT 519) or
Palintest Sample Container 200/100/50 ml glass (PT 505)

Palintest Hardness LR Test Kit CS 117 is a complete kit supplied with a 50/10 ml sample container and sufficient tablets for approximately 40 tests. Palintest Hardness LR Test Kit SS 217 is a complete kit supplied with a 200/100/50 ml sample container and sufficient tablets for approximately 100 tests.

Test Range

The test is normally carried out on a 50 ml sample, although a larger sample may be used if a lower test range is required.. The table below indicates the sample size appropriate to various hardness test ranges.

Test Range	Sample Size
0 - 25 mg/l $CaCO_3$	100 ml
0 - 50 mg/l $CaCO_3$	50 ml

TEST PROCEDURE

1. Select the sample size appropriate to the hardness range under test. Take a sample of the correct size in the Palintest sample container.

2. Add one Hardness LR tablet and shake the container until the tablet disintegrates.

3. Continue adding tablets one at a time in this manner until the colour of the solution changes from plum red to

blue..

4. Note the number of tablets used and calculate the result from the formula below appropriate to the sample volume taken.

Sample Size	Calculation Hardness (mg/l $CaCO_3$)
100 ml	= (No. of Tablets x 2) - 1
50 ml	= (No. of Tablets x 4) - 2

NOTES

1. 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.

2. For a simple routine control test for domestic and industrial water softeners, use the Palintest Hardness Yes/No test.

Palintest
Test Instructions

HARDNESS VLR

Tablet Count Method

Test for Very Low Levels of Hardness in Soft and Softened Waters

0 - 10 mg/l $CaCO_3$

There are a number of situations where it is necessary to measure very low levels of water hardness. These include the testing of very soft natural waters in acid rain areas, and the testing of high quality softened water used in certain industrial processes.

The Palintest Hardness VLR test provides a simple method of checking low levels of water hardness over the range 0 - 10 mg/l $CaCO_3$.

Method

Calcium and magnesium ions, which cause water hardness, are complexed by reaction with ethylenediaminetetraacetic acid (EDTA). Excess calcium and magnesium ions react with a specific indicator to form a distinctive colouration. The Palintest Hardness VLR test uses a tablet reagent containing a standardised amount of EDTA with Eriochrome black as indicator. The test is carried out by adding tablets, one at a time, to a sample of water until the colour changes from plum red to blue. The result is calculated from the number of tablets used in relation to the volume of water sample taken.

Reagents and Equipment

Palintest Hardness VLR Tablets
Palintest Sample Container, 50/10 ml plastic (PT 506, PT 519)

TEST PROCEDURE

1. Fill sample container to the 50 ml mark.

2. Add one Hardness VLR tablet and shake the container until the tablet disintegrates.

3. Continue adding tablets one at a time in this manner until the colour of the solution changes from plum red to blue.

4. Note the number of tablets used and calculate the result from the formula below.

   Hardness (mg/l $CaCO_3$) = No. of Tablets - 1

NOTE

1. 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.

Palintest
Test Instructions

HARDNESS YES/NO

YES/NO Method

Control Test for Industrial and Domestic Water Softeners

4, 8, 20 mg/l $CaCO_3$

Water hardness is caused by the presence of calcium and magnesium salts. High levels of hardness prevent the formation of lather with soap, and can cuase scaling in water systems. This is particularly true in boilers and steam plants. Hardness is an important control test in a wide variety of applications.

The Palintest Hardness YES/NO test provides a simple control test for industrial and domestic water softeners. The test will demonstrate whether the water has been properly softened or whether the softener bed requires regeneration or replacement. The test can be used with the control limit set at a hardness of 4, 8 or 20 mg/l $CaCO_3$.

Method

Calcium and magnesium ions are complexed by reaction with ethylenediaminetetraacetic acid (EDTA). Excess calcium and magnesium ions react with a specific indicator to produce a distinctive colouration. The Palintest Hardness YES/NO test uses a tablet reagent containing a standardised amount of EDTA with screened Eriochrome black as indicator. The test produces a distinctive red/green colour indicator depending on whether the water is above or below a designated hardness control limit.

Reagents and Equipment

Palintest Hardness YES/NO Ttablets
Palintest Sample Container, (PT 506, PT 519 or PT 510)

TEST PROCEDURE

1. Take a sample of water from the softener in the sample container, filling to the 50 ml mark.

2. Add two Hardness YES/NO tablet and shake the container until the tablet disintegrates.

   If the sample turns RED the softener requires regeneration or replacement.

   If the sample turns GREEN softened water is being produced.

NOTE
Under normal operation most water softeners will produce water of negligible hardness. A control limit for the hardness does however, need to be set in order to determine at what point the softener bed requires regeneration or replacement. Different control limits can be set, depending on the specification of the water ultimately required.

When the test is carried out according to the procedure described above, the colour change takes place at a water hardness of 8 mg/l. Water with a hardness below this limit would normally be considered suitable for domestic or general industrial applications.

For certain industrial applications, water from the softener may be required to be controlled at less than 4 mg/l Hardness. In such cases use one Hardness YES/NO tablet in 50 ml water.

For domestic application and some industrial processes a higher hardness control limit of 20 mg/l may be acceptable.

In such cases use one Hardness YES/NO tablet in 10 ml water.

Palintest
Test Instructions

NITRITE

Tablet Count Method
0-1500 mg/l $NaNO_2$

TEST FOR NITRITE IN COOLING WATER

Nitrites and Nitrite-based formulations are widely used for corrosion control in cooling water systems. The Palintest Nitrite test provides a simple means of measuring nitrite for the control of such treatment products in cooling water. The test covers the range 0 - 1500 mg/l $NaNO_2$.

Method

Nitrites are readily oxidized by potassium permanganate under acidic conditions. The Palintest Nitrite test is based on two tablet reagents - an acidifying tablet and a tablet containing a standardised amount of potassium permanganate. The test is carried out by acidifying the sample with the first tablets and then adding the second tablets one at a time until a pink colour persists. The result is calculated from the number of the second tablets used in the test.

Reagents and Equipment

Palintest Nitrite No. 1 Tablets
Palintest Nitrite No. 2 Tablets
Palintest Sample Container 50 / 10 ml plastic (PT 506)
or Palintest Sample Container 100 / 50/ 10 mg/l plastic (PT 510)

Method

1. Filter the sample if necessary to obtain a clear solution.

2. Fill the Palintest sample container to the 10 ml mark. Make up to the 50 ml mark using distilled water or tap water.

3. Add two Nitrite No. 1 tablets, cap the container and shake until the tablets disintegrate.

4. Add one Nitrite No. 2 tablet, cap the container and shake until the tablet disintegrates.

5. Continue adding Nitrite No. 2 tablets, one at a time, in this manner until a pink colour persist for approximately one minute.

6. Note the number of Nitrite No. 2 tablets used and calculate the results from the formula below.

   Nitrite (Mg/l $NaNo_2$) = No. of tablets x 140.

Note

For the measurement of low levels of nitrite in natural, drinking and waste water, use the Palintest Nitricol test.

Palintest
Test Instructions

ORGANOPHOSPHONATE-PHOSPHONATE

Micro Titration Method

TEST FOR ORGANOPHOSPHONATE IN COOLING WATER

0-20 mg/l

The use of organophosphonate compounds as inhibitors in cooling systems has become widespread in recent years. It is essential to monitor the active organophosphonate content of the cooling water to ensure the treatment is fully effective.

The Palintest Organophosphonate test provides a simple means of monitoring organophosphonate levels over the range 0 - 20 mg/l. The test has been developed for use with commercially available organophosphonate products based on amino trimethyl phosphonic acid and hydroxyethane disphosphonic acid - the two compounds most commonly used in these formulations.

Method

Organophosphonate can be titrated with thorium nitrate under acid conditions using xylenol orange as indicator. Ordinarily this test suffers from a number of disadvantages, particularly the poor colour change at the end point and the very precise pH conditions which need to be established. The latter often requires a separate pH titration to be carried out as a forerunner to the main test.

These problems have been eliminated in the Palintest Organophosphonate test which uses a special combined buffer-indicator tablet in conjunction with standard thorium nitrate solution. The tablet contains a screened xylenol orange indicator together with a buffer mixture which provides the correct conditions for the test. This tablet eliminates the tedious pH correction procedure and ensures an improved green to purple end point colour change. A dechlorinating agent has been incorporated so that the test can be used on systems also being treated with chlorine compounds.

Low levels of organophosphonate compounds are used and it is essential that these can be accurately determined under plant conditions. This is achieved by using standard thorium nitrate solution in conjunction with a direct reading titrator–a microburette directly calibrated in terms of organophosphonate concentration. The titrator can be read to a precise of 0.4 mg/l.

Reagents and Equipment

Palintest Organophosphonate No. 1 Tablets
Palintest Organophosphonate No. 2 Solution
Palintest Titrator Tube 10 ml (PT 648)
Palintest Direct Reading Titrator, 0 - 20 mg/l (PT 378)

Method

1. Take a sample of the water under test in the Palintest titrator tube, filling to the 10 ml mark.

2. Add one Organophosphonate No 1 Tablet, crush and mix to dissolve.

3. Fill the direct reading titrator with Organophosphonate No. 2 Solution. The solution is supplied in a special bottle to facilitate filling of the titrator. Ensure there are no air bubbled trapped in the titrator. Adjust so that the solution level coincides with the zero mark.

4. Insert the titrator through the hole in the cap of the titrator tube.

5. Gently depress the plunger on the titrator, adding the solution a drop at a time and shaking the tube gently to ensure mixing.

6. Continue adding the solution until the colour changes from green to purple.

7. Observe the mark corresponding to the solution in the titrator. This figure represents the active organophosphonate concentration in the sample as milligrams per litre.

SEWAGE EFFLUENT TESTS
TESTS FOR PERMANGANATE VALUE, pH, SUSPENDED SOLIDS, AND PROBABLE BOD, COD AND TOC

Palintest Methods
PV 0 - 30+
PH 4 - 10
Turbidity 5 - 500 JTU

Palintest Sewage Effluent Tests provide a simple means of checking the quality of sewage effluents. The tests cover the essential quality control checks required for the day to day operation of sewage works and effluent treatment plants.

Increasing attention is being paid to the quality of sewage effluents. This is coupled with the imposition of more stringent quality standards. It is important that the condition of sewage effluent discharges be checked to ensure they conform to consent limits. Similarly the importance of regular testing by sewage works operators as a check on the efficiency of the works is widely recognized.

Palintest Sewage Effluent Tests have been developed to meet this need. Palintest methods are particularly useful at sewage works and other locations without full laboratory facilities. Each of the tests is performed simply without the use of complicated equipment and are suitable for operators without formal training in water testing and analysis.

Palintest Sewage Effluent Tests are based on those recommended by the Department of the Environment and the Water Research Centre, and accord generally with the methods laid down in "Analysis of Raw, Potable and Waste Waters" published by Her Majesty's Stationery Office. The tests offer simplified methods for Permanganate Value, pH value, Turbidity and Suspended Solids; and indications of probable BOD, COD and TOC values.

Palintest Sewage Effluent Test Kit SP 304 is a complete kit containing tablet reagents and equipment for all of the tests described in this test instruction sheet.

PERMANGANATE VALUE

The Palintest Permanganate Value test is a simplified version of the standard AO test for indicating the general quality of final effluents. The test enables the Permanganate Value (PV) to be determined and the effluent classified as to its acceptability for discharge.

Reagents and Equipment

Palintest Permanganate Value Tablets
Palintest Acidifying SE Tablets
3 Sample Containers 100/50/10 ml, plastic (PT510)

Test Procedure

1. Take three sample containers and fill each to the 100 ml mark with sewage effluent.

2. Add two Acidifying SE tablets to each tube, cap and shake to disintegrate.

3. To the first container add one Permanganate Value tablet, to the second container add two Permanganate Value tablets and to the third container add three Permanganate Value tablets. Cap each tube and shake until the tablets have dissolved.

4. Stand 30 minutes then note how many containers have remained pink. Read the result from the following table.

Containers Pink	Permanganate Value	Grading
All Three	0 - 10	Excellent
Two	10 - 20	Satisfactory
One	20-30	Dubious
None	Over 30	Unsatisfactory

Notes

1. When testing crude sewage, add 10 ml sample to each container and make up to 100 ml mark with deionised water. Proceed with the test as described above then multiply the Permanganate Value obtained by 10.

2. When testing settled sewage, add 20 ml sample to each container and make up to the 100 ml mark with deionised water. The tube is not marked at 20 ml but this can be easily estimated. Proceed with the test as described above and multiply the Permanganate Value obtained by 5.

pH Test

Chemical and biological reactions at sewage works are profoundly influenced by pH. A regular check on the pH of sewage effluent is therefore, essential. A pH test will also check, for example, on the effect of acid or alkaline trade wastes in the effluent flow. The pH test is carried out using a Universal pH test tablet in conjunction with a printed colour strip.

Reagents and Equipment

Palintest Universal pH Tablets
Test Tube 10ml, plastic (PT 511)

Test Procedure

1. Fill the plastic test tube to the top line mark (10 ml).

2. Add one Universal pH tablet, cap tube and shake to dissolve.

3. Compare the solution colour against the printed colour strip provided on the tablet carton.

The test covers the pH range 4 to 10. The expected pH range for raw sewage is 6 to 8, and the pH of final effluents should also fall within the 6 to 8 pH range unless other consent limits are specified.

Turbidity and Suspended Solids

The Turbidity test is designed to give a measure of the suspended solids content of the final effluent. It is also useful

in following the day to day variation in the quality of sewage and effluent.

The Palintest Turbidity Test uses a specially calibrated plastic tube. This provides the simplest possible method of performing this important test. Test kit SP 304 includes a tube graduated at 30 to 500 turbidity units. A double length tube with additional graduations from 5 to 25 turbidity units is optionally available. The Palintest Turbidity Tubes were calibrated by the Department of Public Health Engineering, University of Newcastle upon Tyne.

Equipment

Palintest Turbidity Tube, 13" (PT 514)
or Palintest Turbidity Tube, 28" (PT 528)

Test Procedure

1. Hold the tube vertically over a white surface and view downwards.

2. Gradually pour in the effluent sample until the black cross is just no longer visible.

3. Read off the graduation corresponding to the height of the sample in the tube. This represents the turbidity of the effluent in Jackson Turbidity units (JTU). For sewage effluents the graduations may also be taken as being approximately equivalent to the Suspended Solids Content in milligrams per litre.

The Royal Commission Standards for Effluents recommended that the suspended solids content of sewage effluent should not be more than 30 mg/l.

The tube should be rinsed after use. Any staining may be removed by the use of a household detergent.

BOD, COD and TOC

It is possible to derive an indication of the Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Total Organic Carbon (TOC) from the result of the Permanganate Value test. This is based on the relationship between these measures of organic pollution obtained experimentally for domestic sewage and effluents. (Notes on Water Research, Number 14, Tests for Assessing the Oxygen Demand of effluents, Stevenage Laboratory, Water Research Centre, February 1978.

To convert the Permanganate Value (PV) for domestic sewage and effluent to probable BOD, COD and TOC values multiply by the following factors.

	Sewage	**Effluent**
Probable BOD	PV x 5	PV x 1.5
Probable COD	PV x 10	PV x 7
Probable TOC	PV x 3	PV x 2

There is generally a close relationship between turbidity and the BOD value of settled sewage and effluent. The probable BOD can be calculated from the result of the turbidity test using the following formula -

$$ProbableBOD = \frac{Turbidity}{2} + 5$$

This probable BOD value can be used as a cross check on the probable BOD value obtained from the relationship with the Permanganate Value test.

The Royal Commission Standard for Effluents recommend a BOD value of not more than 20 mg/l.

Temperature

A check should be maintained on the temperature of effluent discharges and these should always be close to ambient temperatures. A check is particularly important on industrial effluents here heated processes are involved.

Sewage Effluent Test Kit SP 304 contains a 0 to 50°C thermometer complete in a brass protecting case (PT 684). Replacement thermometers (PT 683) are available in the event of breakage.

Palintest
Test Instructions

QUATEST

Test for Quaternary Ammonium Compounds and other Cationic Detergents

Tablet Count Method
0 - 500 mg/l
Yes/No Method
200 mg/l

Quaternary Ammonium Compounds (QACs or Quats), and similar cationic detergents, are used as sanitizing germicides in catering, the food and drink industry and similar applications. The uses of these products include the washing of utensils and equipment, surface cleaning, dish washing rinse water and other applications where germ free conditions must be maintained.

The Palintest Quatest method provides a simple means of measuring QAC levels in detergent use solutions over the range 0 - 500 mg/l active QAC. The Quatest test can also be used as a simple control test for QAC levels at 200 mg/l - a commonly used concentration.

The Quatest method was standardized using a recognized standard Quaternary Ammonium Compound consisting of n-alkyl (50% C_{14}, 40% C_{12}, 10% C_{16}) dimethyl benzyl ammonium chloride. Test results are expressed as 'mg/l active QAC' in terms of the compound.

Commercial detergent products may contain different types of quaternary ammonium compounds or other cationic compounds in solutions of varying concentration, and may be formulated with other ingredients. To calculate the dosage of commercial products from the test result, regard must be paid to the active content of the detergent product in use.

Method

Cationic detergents, including Quaternary Ammonium Compounds, form an intense blue colour with certain sulphone phthalein indicators. Cationic compounds, moreover can be neutralized by reaction with anionic detergents. The Palintest Quatest method is based on the use of a single tablet reagent containing both an indicator and a standardized amount of anionic detergent. In the test procedure, the reagent tablet reacts with the Quaternary Ammonium Compound in the test sample to produce a definite blue to purple colour change.

Reagents and Equipment

Palintest Quatest Tablets
Palintest Sample Container, 50/10 ml plastic (PT 506, PT 519)

TEST PROCEDURE - Tablet Count Method

1. Fill sample container to the 50 ml mark.

2. Add one Quatest tablet and shake the container until the tablet disintegrates.

3. Continue adding tablets one at a time in this manner until the colour changes from blue to purple.

4. Note the number of tablets used and calculate the result from the formula below:

   Active QAC (mg/l) = (No. Of tablets x 40) - 20

Test Procedure - Yes/No Method

1. Fill sample container to the 10 ml mark.

2. Add one Quatest tablet and shake the container until the tablet disintegrates.

3. Note the colour of the test solution.

   A PURPLE colour indicates that the solution contains less than 200 mg/l active QAC.

   A BLUE colour indicates that the solution contains more than 200 mg/l active QAC

Palintest
Test Instructions

SULPHATE (TURB)

Turbidity Method

Test for Sulphate
in Natural and Treated Waters

0 - 200 mg/l
0 - 3000 mg/l

Sulphates occur naturally in many waters. Sulphates are introduced into treated waters by the use of such chemicals as aluminum sulphate, sodium bisulphate (dry acid) and sulphuric acid. The presence of high levels of sulphate can be undesirable for a number of reasons.

In industrial waters localised corrosion of iron, steel and aluminum in plant and pipework can occur through the action of sulphate-reducing bacteria. These bacteria, which generate sulphides, cause a characteristic pitting of the metal surface. High sulphate levels can also cause damage to concrete and cement based materials through the formation of calcium sulphoaluminate. This causes expansion and crumbling of the cement. It can affect concrete structures and pipes in water distribution systems carrying sulphate-bearing ground waters; and can attack grouting in tiled swimming pools using sodium bisulphate for pH adjustment.

The Palintest Sulphate (Turb) test provides a simple method of measuring sulphates over the range 0 - 200 mg/l SO_4. Levels up to 3000 mg/l may, however, be determined using the dilution procedure outlined.

Method

The Palintest Sulphate (Turb) test is based on a single tablet reagent containing barium chloride in a slightly acidic formulation. Barium salts react with sulphates to form insoluble barium sulphate. At the sulphate levels encountered in the test, this is observed as turbidity in the test sample. The degree of turbidity is proportional to the sulphate concentration and is measured using a special double tube assembly.

Reagents and Equipment

Palintest Sulphate (Turb) Tablets
Palintest Double Tube Assembly (PT 509)

Palintest Sulphate Test Kit CS 132 is a complete kit containing the above equipment and tablets for 100 tests.

TEST PROCEDURE

1. Separate the tubes of the double tube assembly and fill the round outer tube to the top line with the sample under test.

2. Add one Sulphate (Turb) tablet. Cap the tube and shake gently to disintegrate the tablet disintegrates. A cloudy solution indicates the presence of sulphate.

3. Insert the square graduated inner tube into the outer tube the, viewing from the top, move the inner tube up and down until the black spot on the bottom is just no longer visible.

4. Read the graduation mark on the inner tube level with the top of the solution in the tubes. **Multiply this figure by 2**. This represents the sulphate level in the water expressed as milligrams per litre SO_4.

If the solution is too cloudy to obtain a reading, this indicates the sulphate level is over 200 mg/l. Repeat the test on a diluted sample as outlined in the following section.

Dilution Procedure

To measure higher levels of sulphate, a smaller sample of water should be taken using the small measuring tube. Select the sample size appropriate to the sulphate range under test by reference to the table below:

Sample Size	Test Range	Factor Multiply tube reading by
7.5 ml	0 - 400 mg/l	4
4 ml	0 - 750 mg/l	7.5
2 ml	0 - 1500 mg/l	15
1 ml	0 - 3000 mg/l	30

Take a sample of appropriate volume and transfer to the round outer tube of the double tube assembly. Then fill the round outer tube to the top line with distilled water. Carry out the test as indicated in the test procedure then multiply the tube reading by the factor indicated in the table above appropriate to the sample size selected. This then represents the sulphate concentration in the original sample as mg/l SO_4.

Caution

Palintest Sulphate (Turb) Tablets each contain mg barium chloride. These tablets are harmful if ingested. Avoid handling tablets whenever possible and wash hands after use.

Palintest
Test Instructions

SULPHITE

Test for Sulphite in Boiler Water

Tablet Count Method
0 - 50 mg/l Na_2SO_3
0 - 500 mg/l Na_2SO_3

Oxygen is a major cause of corrosion in boilers and steam plants. Sodium sulphite and catalysed sulphite formulations are extensively used as oxygen scavengers in boiler water treatment.

The Palintest Sulphite tests provide a simple means of measuring sulphite levels for the control of such treatments in boiler plant. The test is available in low range and high range forms covering sulphite levels 0 - 50 mg/l and 0 - 500 mg/l Na_2SO_3.

Method

Sulphites react with iodine under acidic conditions. Iodine can be readily detected by a blue colouration formed with starch indicator. The Palintest Sulphite test is based on two tablet reagents - an acidifying tablet and a tablet containing a standardised amount of an iodine release mixture and a starch indicator system. The test is carried out by acidifying the sample with the first tablets and then adding the second tablet, one at a time, until a blue colouration appears. The result is calculated from the number of the second tablets used in the test.

Reagents and Equipment

Palintest Sulphite No. 1 Tablets
Palintest Sulphite No. 2 LR or Sulphite No. 2 HR Tablets (see below)
Palintest Sample Container, 50/10 ml plastic (PT 506, PT 519)
Palintest Sample Container 100/50/10 ml plastic (PT 510)

Sulphite No. 2 LR tablets cover the range 0 - 50 mg/l Na_2SO_3.
Sulphite No. 2 HR tablets cover the range 0 - 500 mg/l Na_2SO_3.

TEST PROCEDURE

1. Filter sample if necessary to obtain a clear solution.

2. Fill the sample container to the 50 ml mark.

3. Add two Sulphite No. 1 tablets, cap the container and swirl gently until the tablets disintegrate.

4. Add one Sulphite No. 2 LR or one Sulphite No. 2 HR tablet, as appropriate for the range being tested. Cap the container and swirl gently until the tablet disintegrates.

5. Continue adding Sulphite No. 2 LR or Sulphite No. 2 HR tablets one at a time in this manner until a blue colouration appears.

6. Note the number of Sulphite No. 2 LR or Sulphite No. 2 HR tablets used and calculate the result from the formula below.

For Sulphite LR

Sulphite (mg/l Na_2SO_3.) = (No of tablets x 4) - 2

For Sulphite HR

Sulphite (mg/l Na_2SO_3.) = (No of tablets x 40) - 20

Palintest
Test Instructions

TANNIN

Test for Tannin
in Boiler and Cooling Water

Tablet Count Method
0 - 20 units
0 - 200 mg/l

Tannin and tannin-based formulations have a long established use for scale prevention and corrosion control in boiler waters and cooling systems. Tannin acts to modify the crystal growth of calcium and magnesium salts and thus prevents the formation of hard scale. Corrosion is inhibited by the reaction of the tannin with oxygen, and by the formulation of a tannate film on metal surfaces.

The Palintest Tannin test provides a simple means of measuring tannin for the control of such treatments in boiler waters and cooling waters. The test results can be expressed either in terms of the Tannin Index or as tannin concentration and cover the ranges 0 - 20 units and 0 - 200 mg/l respectively.

Method

Tannins are readily oxidized by potassium permanganate under acidic conditions. The Palintest Tannin test is based on two tablet reagents - an acidifying tablet and a tablet containing a standardised amount of potassium permanganate. The test is carried out by acidifying the sample with the first tablets and then adding the second tablet, one at a time, until a pink colour persists. The result is calculated from the number of the second tablets used in the test.

Reagents and Equipment

Palintest Tannin No. 1 Tablets
Palintest Tannin No. 2 Tablets
Palintest Sample Container, 50/10 ml plastic (PT 506, PT 519)
Palintest Sample Container 100/50/10 ml plastic (PT 510)

Tannin No. 2 LR tablets cover the range 0 - 50 mg/l Na_2SO_3.
Tannin No. 2 HR tablets cover the range 0 - 500 mg/l Na_2SO_3.

TEST PROCEDURE

1. Filter sample if necessary to obtain a clear solution.

2. Fill the sample container to the 50 ml mark.

3. Add two Tannin No. 1 tablets, cap the container and shake until the tablets disintegrate.

4. Continue adding Tannin No. 2 tablets one at a time in this manner until a pink colour persists for approximately one minute.

5. Note the number of Tannin No. 2 tablets used and calculate the result from the formula below.

   Tannin Index = No of tablets x 2

   or

   Tannin mg/l = No of tablets x 20

Palintest
Test Instructions

TOTAL ALKALINITY

Tablet Count Method

Test for Total Alkalinity in Natural and Treated Waters

0 - 500 mg/l $CaCO_3$

Natural and treated waters may contain a variety of dissolved alkaline substances such as carbonates, bicarbonates, hydroxides and, to a lesser extent, borates, phosphates, and silicates. In most waters at normal pH levels the alkalinity results mainly from the presence of bicarbonates. The Total Alkalinity test provides a measure of the total quantity of alkaline substances dissolved in the water.

The total alkalinity is an important test in determining the aggressiveness or the scale forming tendency of the water. If the total alkalinity is low the water may be aggressive and cause corrosion to pipe work and structures; of the total alkalinity is high the water may more readily promote scale formation. Alkalinity control is therefore an important part of many water treatment programmes.

The Palintest Total Alkalinity Test covers the range 0 - 500 mg/l $CaCO_3$. The test is particularly suitable for checking natural and drinking waters, swimming pool waters, effluents, etc.

Method

Alkalinity is the capacity of a water to react with acid to a specified pH, 4.5 - 5.0 in the case of the total alkalinity test. . The Palintest Total Alkalinity test uses a tablet reagent containing a standardized amount of acid together with a pH indicator which is designed to change colour within this pH range. The test is carried out by adding tablets, one at a time, to a sample of water until the colour changes from yellow to bright red. The result is calculated from the number of tablets used in relation to the volume of water sample taken.

Reagents and Equipment

Palintest Total Alkalinity tablets
Palintest Sample Container, 50/10 ml plastic (PT 506, PT 519)

Test Range

The test is normally carried out on a 50 ml sample, although a larger sample may be used if a lower test range is required. The table below indicates the test range and sample size appropriate to different alkalinity test ranges.

Test Range	Sample Size
0 - 250 mg/l $CaCO_3$	100 ml
0 - 500 mg/l Cl	50 ml

TEST PROCEDURE

1. Select the sample size appropriate to the total alkalinity under test. Take a sample of the appropriate size in the Palintest sample container.

2. Add one Total Alkalinity tablet and shake the container until the tablet disintegrates.

3. Continue adding tablets one at a time in this manner until the colour of the solution changes from yellow to

bright red. (Ignore any intermediate orange-pink colouration).

4. Note the number of tablets used and calculate the result from the formula below appropriate to the sample volume taken.

Sample Size	Calculation Total Alkalinity (mg/l $CaCO_3$)
100 ml	= (No. of Tablets x 20) x10
50 ml	= (No. of Tablets x 40) - 20

Relationship between Alkalinity and Hardness

Certain calcium and magnesium salts contribute to both the alkalinity and the hardness of the water. The relationship between the total alkalinity and the total hardness of the water can be used to determine whether the water hardness is temporary or permanent. Temporary hardness is the hardness which can be removed by boiling the water, permanent hardness is the hardness which remains even when the water has been boiled.

If the Total Hardness is greater than the Total Alkalinity then:

Temporary Hardness = Total Alkalinity

Permanent Hardness = Total Hardness - Total Alkalinity

If the Total Hardness is less than the Total Alkalinity then:

Temporary Hardness = Total Hardness

ie all of the hardness is temporary.

Notes

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

2. Full evaluation of the aggressiveness or scale forming tendency of water, see the Palintest Balanced Water Test. The Balanced Water Index is a calculated function which takes into account the total alkalinity, calcium hardness, pH and temperature of the water.