Boiler Water No.2 Test Kit

Instruction Manual

56I015001 Version P1

BOILER WATER No.2

Steam boilers require careful treatment in order to maintain efficiency, steam purity and to prevent scale and corrosion of pipework and heat exchangers.

A phosphate/sulphite treatment program is a very effective way to treat medium pressure boiler systems to maintain efficiency. The Boiler Water No.2 test kit contains a full suite of tests to monitor all aspects of this program.

Refer to the operation control parameters for the boiler or refer to your water treatment specialist for advice on control levels for the following:

Alkalinity (caustic) – drop test
Boiler water systems typically operate in alkaline conditions to prevent corrosion. The concentration of caustic (OH^-) alkalinity can be determined using the drop test provided. It is possible to derive values for caustic and non-caustic alkalinity by measuring both P and OH alkalinities.

Chloride - drop test
Chloride will increase the corrosive nature of boiler water if the concentration is too high. Check regularly to ensure levels remain under control.

Conductivity (TDS) – SD70 conductivity meter
Water conductivity increases with an increase in the concentration of ionic dissolved material. If dissolved solids are too high the boiler water is likely to foam and carry over impurities with the steam. Boilers should “blowdown” if dissolved solids are too high.

Total Dissolved Solids = Conductivity Reading x 0.7

Hardness – drop test
Hardness, in the form of calcium and magnesium is removed from boiler feedwater by the softening plant. However traces can still carry into the boiler and over time can plate onto internal surfaces and reduce heat transfer efficiency. It is therefore important to regularly monitor the efficiency of the softening plant to ensure that it is functioning properly.

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Phosphate (ortho) – comparator test

Phosphate is added to boiler water as a scale conditioner. Any free hardness salts (calcium & magnesium) react with phosphate to form crystalline solids that do not plate onto surfaces. These solids fall to the bottom of the boiler and can be easily removed. As such, a phosphate reserve should always be maintained in the boiler water.

pH – SD50 Meter

It is easier to treat high pH water for the tendency to form scale than it is to treat acidic water for the tendency to corrode metal. Boiler water pH is therefore maintained at around pH 11 by the addition of caustic (OH^-) treatments. Regularly testing for pH is a quick way to confirm the presence of the alkaline treatment.

Sulphite – drop test

It is important to remove as much oxygen as possible from boiler feedwater as this reduces the possibility of corrosion. Deaerators will remove most of the dissolved oxygen, but traces will still be present and after time can cause problems in the boiler. Sulphite is added as an oxygen scavenger. Any traces of oxygen will react with sulphite to form sulphate. It is important to maintain a sulphite reserve at all times.

Notes

1. Carry out the tests on cooled boiler (feed)water as quickly as possible to prevent any reaction of the sampled water with atmospheric oxygen.
2. Filter the sample water before testing for phosphate using a GF/C filter paper. Crystalline phosphate salts will be removed by filtration in order to measure freely dissolved phosphate.
3. Boiler water samples must be neutralised before measuring conductivity (TDS) with the SD70 meter. Add drops of **KS24 – Alkalinity Neutralising Solution** to the sample until it turns from pink to colourless. The sample is then ready for testing. Adding KS24 will not increase water conductivity.
4. pH and conductivity meters should be calibrated regularly using the standards provided. Failure to calibrate may result in inaccurate readings being made.

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P Alkalinity Range: 50 – 2400mg/l (as $CaCO_3$)

Take sample according to expected range. (See table below)	Add drops of **KS135 – PA1/ALK1 (Phenolphthalein Indicator)** to give a **Pink** colour.	If sample remains **colourless**, report the P Alkalinity as zero.	Count drops of: **KS139 - TA3 or KS136 - PA2/TA2** until **colourless**. Record the number of drops added.

Colours may vary depending on sample and test conditions.

P Alkalinity (as $CaCO_3$) mg/l = Number of Drops x Factor (from the table)

ppm = mg/l

Expected Range (mg/l)	Titrant Used	Sample Size (ml)	Factor
50-150	KS139 – TA3	40	5
100-300	KS139 – TA3	20	10
200-600	KS139 – TA3	10	20
200 – 600	KS136 - PA2/TA2	40	20
400 – 1200	KS136 - PA2/TA2	20	40
800 – 2400	KS136 - PA2/TA2	10	80

NOTE
The P refers to phenolphthalein the indicator originally used for titrating P Alkalinity.
The colour change occurs at pH 8.3.
Less hazardous alternatives are now used.

Alkalinity Relationships
The separate contributions to alkalinity from free caustic, carbonate and bicarbonate can be estimated using the P & M alkalinity relationship in the table below.

If	OH	CO_3	HCO_3
P = 0	0	0	M
P < M/2	0	2P	M – 2P
P = M/ 2	0	2P	0
P > M/2	2P – M	2 (M – P)	0
P = M	M	0	0

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OH Alkalinity (Caustic) Range: 50 – 2400mg/l (as $CaCO_3$)

Take sample according to expected range. (See table below)	Add 3 drops of **KS135 – PA1/ALK1** **(Phenolphthalein Indicator)** to give a **Pink** colour, followed by 10 drops of **KS137 – PA3** **(Barium Chloride)**	If sample remains **colourless**, report the P Alkalinity as zero.	Count drops of: **KS139 - TA3 or KS136 - PA2/TA2** until **colourless**. Record the number of drops added.

Colours may vary depending on sample and test conditions.

OH Alkalinity (as $CaCO_3$) mg/l = Number of Drops x Factor (from the table)

ppm = mg/l

Expected Range (mg/l)	Titrant Used	Sample Size (ml)	Factor
50-150	KS139 – TA3	40	5
100-300	KS139 – TA3	20	10
200-600	KS139 – TA3	10	20
200 – 600	KS136 - PA2/TA2	40	20
400 – 1200	KS136 - PA2/TA2	20	40
800 – 2400	KS136 - PA2/TA2	10	80

NOTE

Barium chloride precipitates with carbonate ions to produce a white precipitate in the test. The remaining alkalinity present in the sample is attributed to the presence of hydroxide ions (OH).

Alkalinity Relationships

The separate contributions to alkalinity from free caustic, carbonate and bicarbonate can also be estimated using the P & M alkalinity relationship in the table below.

If	OH	CO_3	HCO_3
P = 0	0	0	M
P < M/2	0	2P	M – 2P
P = M/ 2	0	2P	0
P > M/2	2P – M	2 (M – P)	0
P = M	M	0	0

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Chloride **Range: 20 – 12,000mg/l (as Cl^-)**

Take sample according to expected range. (See table below) *(Neutralise sample first – see note below).*	Add 10 drops of **KS140 – BC1/CC1 (Potassium Chromate)** to give a **yellow** colour.	Add drops of: **KS142 – CC2 or KS141 – BC2** One drop at a time, swirling between drops.	Record the number of drops added to change the colour to **Orange/Brown.**

Colours may vary depending on sample and test conditions.

Chloride (as Cl^-) mg/l = Number of Drops x Factor (from the table)

ppm = mg/l

Expected Range (mg/l)	Titrant Used	Sample Size (ml)	Factor
20 - 75	KS141 – CC2	40	2.5
50 - 150	KS141 – CC2	20	5
100 - 400	KS141 – CC2	10	10
100 - 400	KS142 – BC2	40	10
200 - 600	KS142 – BC2	20	20
400 - 1000	KS142 – BC2	10	40
800 - 3000	KS142 – BC2	5 *	80
2000 - 6000	KS142 – BC2	2 *	200
4000 - 12,000	KS142 – BC2	1 *	400
*Dilute samples of less than 10ml to approximately 10 - 20ml with distilled or deionised (chloride free) water.			

NOTE

Alkaline samples such as boiler water will require neutralisation prior to testing. Add drops of **KS24 – Alkalinity Neutralising Reagent** one drop at a time until the sample turns colourless. The sample is now ready for testing. Or carry out the P Alkalinity test first and then continue with the chloride test.

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Hardness (Total) Range: 5 – 60 mg/l (as $CaCO_3$)

Take sample according to expected range. (See table below) If copper is present above 1ppm, see Note 2 below.	Add 4 drops of **KS160 – TH2** **(Total Hardness Buffer)** per 10ml of sample and mix.	Add 4 drops of **KS164 – TH5** **(Total Hardness Indicator)** per 10ml of sample or sufficient **KP283 – TH1P**** **(T. Hardness Ind Powder)** to produce a good **wine red** colour when mixed.	Count drops of: **KS162 – TH3** until the sample turns **Pure Blue**. Record the number of drops added.

Colours may vary depending on sample and test conditions.

Total Hardness (as $CaCO_3$) mg/l = Number of Drops x Factor (from the table)

ppm = mg/l

Expected Range (mg/l)	Titrant Used	Sample Size (ml)	Factor
5 - 15	KS139 – TH3	40	0.5
10 - 30	KS139 – TH3	20	1
20 - 60	KS139 – TH3	10	2

**** NOTE 1**

KT326 – TH1 (Total Hardness Indicator Tablets) can also be used as the indicator in step 3. Add one tablet per test, but DO NOT crush. Swirl gently until a suitable depth of colour is observed, then proceed to step 4.

NOTE 2

More than 1ppm copper in the sample will prevent the pure blue endpoint from occurring, To remove copper interference, add 1 drop of **KS63 – FE6 – Thioglycolate Reagent** before the addition of KS160 – TH2. KS63 is not supplied as standard in the hardness test pack, but can be purchased separately.

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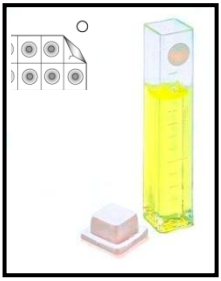
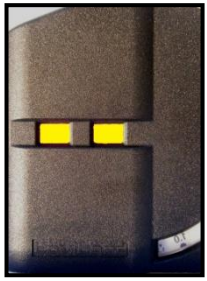
Phosphate HR **Range: 0-80mg/l (as PO_4)**

Fill both cells with **10ml of sample** (filtered). Place one in the left side of the comparator.	Add one **KT81 - Phosphate HR Tablet** to the other cell. Cap and invert gently to dissolve the tablet.	Place this cell in the right side of comparator.	Rotate disc until colour match is obtained. Record disc reading.





Turbid samples should be filtered prior to analysis for best colour match

Disc Reading = Ortho Phosphate (as mg/l PO_4)

NOTES

Boiler water samples should be pre-filtered using GF/C grade filter paper (or equivalent) to remove any suspended/particulate phosphate as this will add to the observed result.

Boiler water treated with tannin will be dark in colour. Addition of the Phosphate HR Tablet should remove sufficient colour to enable colour matching to the disc. However some colour will be left that will require compensation. Acidify the blank cell with one of the following reagents:
KP146 – TN1 - Sulphamic Acid : One scoop
KS278 - Sulphuric Acid 50% : 10 drops
(Other strong acidifiers can also be used if the above are not available)

If the colour produced exceeds the value of the maximum disc standard, dilute the sample and multiply the result obtained by the dilution factor.

PO_4 x 0.33 = P

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Sulphite — Range: 25 – 150 mg/l (as Na_2SO_3)

Test procedure for the determination of sodium sulphite in boiler water.

Take **20ml** of cooled sample in the titration jar.	Add 1 scoop of **KP186 – S1** **(Acid/Starch Powder)** **Or one** **Sulphite No.1 Tablet** and crush/mix gently to dissolve. (It is not necessary for all of the powder to dissolve)	Add drops of **KS187 – S2** **(Sulphite Titrant)** One drop at a time, mixing gently between each addition.	Count how many drops of **KS187 – S2** are required to turn the sample **from Colourless** to **Blue** Record the number of drops added.

Colours may vary depending on sample and test conditions.

Sulphite (Na_2SO_3) mg/l = Number of Drops x 5

ppm = mg/l

NOTES

1. Catalysed sulphite reacts quickly with atmospheric oxygen when hot, so the sample should be cooled during collection with the minimum of contact with air. Do not leave the sample standing. It should be tested immediately after it has cooled. Care should be taken when obtaining samples. Samples should only be taken using a sample cooler that cools the sample to below 30°C

2. Ignore any undissolved material after powder/tablet addition.

3. For concentrations of sodium sulphite above 150mg/l take a 10ml sample and use a factor of 10 i.e. each drop of **KS187 – S2** used = 10mg/l Na_2SO_3.

4. Sulphite reserve may be expressed in different ways. To convert readings from sodium sulphite multiply the result obtained by the following factors.
   Sodium sulphite to sodium metabisulphite x 0.8
   Sodium sulphite to sulphite x 0.63

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pH Measurement

Correct pH readings will give a good indication that caustic treatment is active in the boiler.

Quick Start Guide:

(For full features, see the instruction booklet supplied)

Press and hold for 3 seconds to turn off.

Press to hold reading - (!) appears on LCD

Press for backlight on/off

Press for 3 seconds to store data

After 3 seconds the storage location (eg. 01) appears shortly on the display. Once the storage has reached maximum capacity, the data will overwrite the oldest files.

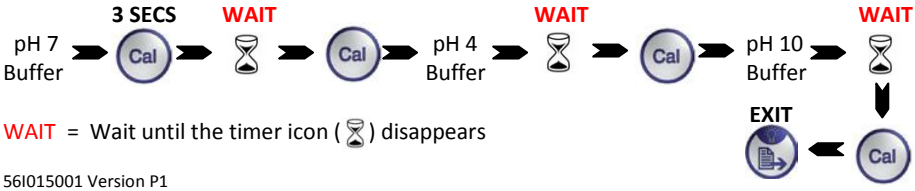
* Re-Calibrate regularly to maintain accuracy.
* Rinse the electrode with distilled water after each reading.
* If temperature is out of range, "ERR" will appear, then return to measurement mode automatically.
* If the default reading is more than 30% off compare to the standard buffer, "ERR" will appear.

Calibration: Auto-recognition for pH 4 (L), pH 7 (M) and pH 10 (H) buffer solutions.

One point calibration:

Two Point Calibration

Three Point Calibration



WAIT = Wait until the timer icon ( ) disappears

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Conductivity/TDS/Temperature (SD70 Meter)

An SD70 conductivity meter is supplied to measure water conductivity. Multiplying the result by 0.7 will convert the reading to total dissolved solids (TDS). Temperature is displayed directly on screen during pH measurement.

Quick Start Guide:
(For full features, see the instruction booklet supplied)

Press and hold for 3 seconds to turn off.

Press to hold reading - (!) appears on LCD

Press for backlight on/off

Press for 3 seconds to store data

After 3 sec. appears shortly the file no. on the display, e.g. 01. Once the storage has reached maximum capacity, the data will overwrite the oldest files.

* Re-Calibrate regularly to maintain accuracy.
* Rinse the electrode with distilled water after each reading.
* If temperature is out of range, “ERR” will appear, then return to measurement mode automatically.
* If the default reading is more than 30% off compare to the standard buffer, “ERR“ will appear.

Calibration

Auto-recognition for 1413µS and 12.88mS

Press “Cal” for 3 seconds (CAL with blink in LCD) - Then Press Wait for CAL to disappear

The instrument is now calibrated. Rinse with a small quantity of sample water then immerse the probe in sample water to display the conductivity result.