

NPK-Kit Detailed Manual

Intro

The NPK Meter from EDT directION enables the operator to measure the N (Nitrogen), P (Phosphorus) and K (Potassium) in aqueous nutrient feed and drain samples. Measuring soil or solid fertilizer samples is also possible after some sample preparation.

During its three-year development the NPK meter was trialled at over a dozen grower sites. Each grower had a common goal. To reduce the consumption of Nitrate based fertilizer/ nutrient feed and water. At the same time maintain yield and quality of the produce. To reduce something, you need to measure it! The NPK meter allows the user to measure key parameters and make real time decisions without having to wait for laboratory results which can take weeks.

calibrated and then rinsed between samples which can be organised in convenient rows.

Principles of Measurement

The NPK meter is an Ion analyser connected to a multiprobe sonde comprising of three Ion Selective Electrodes (ISE's) and a reference electrode.

The ISE's directly measure Nitrate and Potassium ions in the sample. Phosphate is measured indirectly following the addition of two reagents which produce an analyte that can be measured by ISE. This test was developed by EDT directION and is proprietary.

As required by growers the results are reported as N, P and K in parts per million (ppm).

Unpacking the NPK Meter Kit

The Kit contains everything you need for running tests on site. The Kit comprises the following:

- NPK Meter
- Multiparameter Sonde with replaceable N, P, K and Reference electrodes
- MultiCal 1 and MultiCal 2 Calibration Solutions (500ml)
- Phosphate Reagents A and B (500ml and 100ml)
- Measuring Cylinder (50ml)
- Syringes (5ml) for Reagent A and Reagent B
- Sample Beaker (100ml)
- Stirrer
- Portable Robust Carry Case



The NPK meter is portable so can be used to carry out immediate spot-tests on site. If you just need to measure N or N and K it is possible to miss the Phosphate test which means that there is no need for any additional reagent additions.

If however, you are collecting multiple samples and measuring them in batches we strongly recommend using the Accessory sample Rack with a set of 100ml beakers.

This speeds up the test and allows the probe to be easily calibrated and then rinsed between samples which can be organised in convenient rows.

Meter Setup

The NPK meter is supplied with 4 AA batteries.

Using a crosshead screwdriver open the rear battery compartment and insert the batteries in accordance with the guide in the compartment.

Replace the cover.

Setting the Parameters

Before making sample measurements we recommend that the recommended parameters are set.

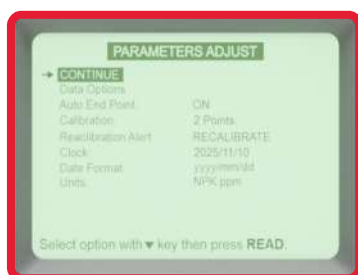
Press the **ON/OFF** button to display the splash screen.

The meter will then go into the 'UNCALIBRATED NPK' display page.

Do not press the **READ** button to 'condition' the probe at this point.

Press the ➡ arrow button. You will now be on the 'UNCALIBRATED' Measure screen.

Now press the ➡ button again to display the 'PARAMETERS ADJUST' screen.

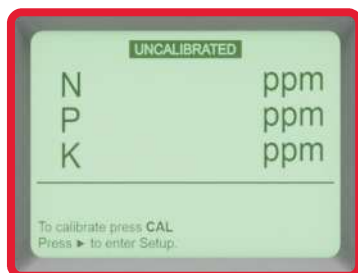


Check that the Auto End Point is set to ON. If not scroll down using the ▼ key and press **READ** to toggle between ON/OFF

Check That Calibration is set to 2 Points. If not scroll down using the ▼ key and press **READ** to toggle between 1 Point and 2 Points.

Finally check that Units are set as 'NPK ppm'. If not scroll down using the ▼ key and press **READ** to scroll through the options until 'NPK ppm' is displayed.

Press the ▼ key until 'CONTINUE' is highlighted then press **READ** to store the settings and return to the measurement page.



You are now ready to Calibrate the unit.

Calibration

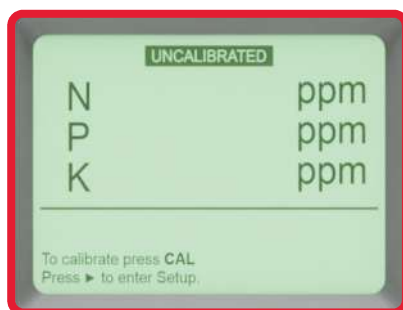
If this is the first time you have used the NPK Meter, the probe should be conditioned. Press the **ON/OFF** button to turn the unit off and then on again.

To condition the probe, connect the sonde to the meter unscrew and remove the outer protective sleeve. Remove the rubber boot from the bottom of the reference electrode. Keep this in a safe place.

Rinse the tip of the sonde in deionised water and place into a beaker of MultiCal 1 standard solution. Press **READ**, this will start a 20-minute 'CONDITIONING' countdown timer.

If you do not need to condition the probe e.g. if it has been used or calibrated recently press the ➡ button to escape this step.

If you have pressed the ➡ arrow or the conditioning has completed, you will see the 'UNCALIBRATED' NPK screen.



If the meter has been calibrated, you will be on the 'CALIBRATED' NPK screen.

You are now ready to run a Calibration:

1. Place the Sonde into a beaker containing 20-50ml of MultiCal 1 solution. Stir the solution with the Sonde and leave it to stand, then press **CAL**.
2. Press **N** to start the Calibration.
3. When the N display is automatically set to 50ppm press the **K** button.
4. When the K display is automatically set to 50ppm press the **P** button.
5. The display will stabilise and set the P display to 10ppm. Note you do not need P Reagent A or B to perform a calibration.
6. Remove the Sonde from the Multi Cal 1 Standard and dab off the excess solution from the Sonde with a tissue.
7. Insert the Sonde into a beaker containing 20-50ml of MultiCal 2 solution and repeat steps 2-5 above.

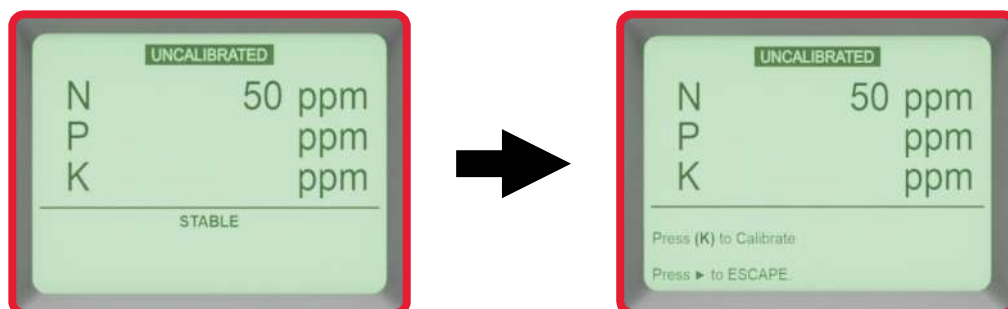
The NPK Meter and Sonde are now Calibrated. Remove the Sonde from the calibration solution and rinse with deionised water and dab with a tissue.

You should be on the measurement screen and 'CALIBRATED' should be displayed at the top-centre of the screen.

Measuring a Sample

Before you measure a sample you should ensure you have the 50ml measuring cylinder, 100ml beaker, Reagent A and B with their syringes and the stirrer to hand.

1. Measure out 50ml of sample using the measuring cylinder and pour into the 100ml beaker.
2. Place the sonde into the beaker containing the sample. Stir the solution with the Sonde, leave the Sonde to stand in the sample and press **READ**.
3. When the N display is stable the result will be shown. Press the **K** button.



4. When the K display is stable the result will be shown.
5. Remove the Sonde, dab with a tissue and place it to one side into an empty clean beaker.
6. Add 5ml of Reagent A to the sample using the Green Syringe provided when prompted. Press **P** and stir the solution with the stirrer provided. The 60 second timer will start.
7. When requested to do so add 5ml of Reagent B with the Red Syringe. Press **P** and stir the solution. The 60 second counter will start.
8. Around 10 seconds before the end of the countdown insert the Sonde into the sample beaker and stir. Leave to stand and wait for the counter to finish.
9. The P value will be displayed. When stable the result will be shown in ppm P.
10. Remove the Sonde from the sample and rinse with deionised water. Dab with a tissue.
11. You are now ready to measure another sample.
12. When you have completed your tests rinse the Sonde with deionised water and dab dry. Replace the boot on the reference electrode and replace the threaded sleeve. Keep the Sonde stored dry in the NPK case provided.

Note 1: Always ensure the colour coded syringes are used with the correct reagents. Mixing them could affect your P result.

Note 2: If you do not want to measure P i.e. only require an N and K result you can escape by pressing the ➡ arrow after step 5 above.

Note 3: If you have a limited sample volume you can run the test with 25ml of sample. You must then add only 2.5ml of Reagent A and Reagent B to complete the P test.

Interpretation of Results

The results are displayed in parts per million (ppm) Nitrogen, Phosphorus and Potassium. This is equivalent to mg/l.

To convert these results into Nitrate, Phosphate and Potassium use the following factors:

N ppm: Convert to Nitrate by multiplying by 4.43.

e.g. 100ppm **N** = 443ppm **NO₃⁻**

P ppm: Convert to Phosphate by multiplying by 3.07.

e.g. 100ppm **P** = 307ppm **PO₄³⁻**

K ppm does not need conversion.

The ISE's in the Sonde are Nitrate, Potassium and an indirect Phosphate sensor.

One-Point Calibration

It is possible to skip the second point of the calibration process. This will speed up the measurement but it is not as accurate as the 2-point calibration. The results achieved after a 1-point calibration are therefore a guide only as the error could be significant.

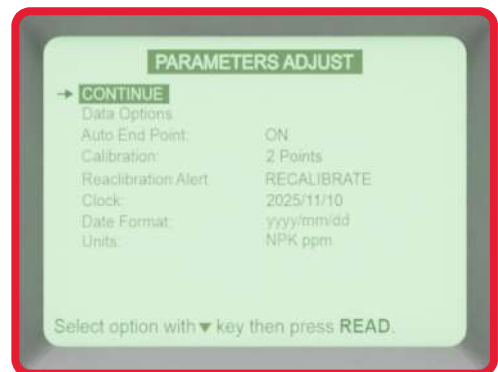
When the first point calibration is performed the theoretical slope is applied and extrapolated across the range. The further away the response of the sensor is from the theoretical slope the bigger the error.

The Procedure:

With the meter in the Measurement screen press the ➡ button to display the 'PARAMETERS ADJUST' screen.

Check that the 'Auto End Point' is set to 'ON'. If not scroll down using the ↓ key and press **READ** to toggle between ON/OFF

Scroll down using the ↓ key to the 'CALIBRATION' display and press **READ** to toggle between 1-Point and 2-Points. Set to '1-point'



Finally check that Units are set as 'NPK ppm'. If not scroll down using the ↓ key and press **READ** to scroll through the options until NPK ppm is displayed.

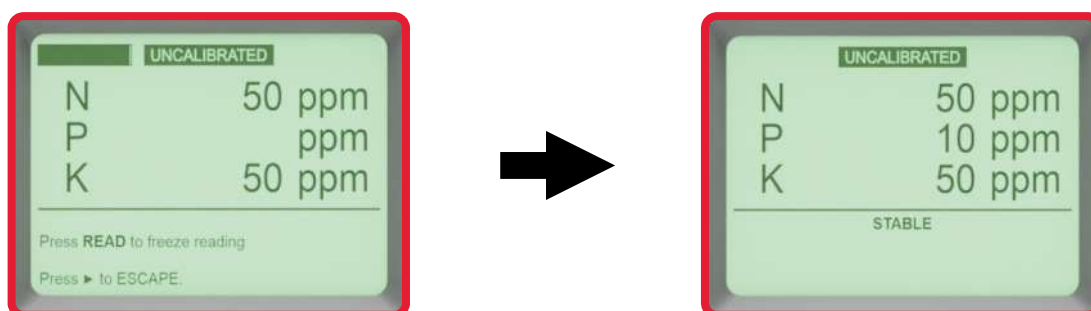
Press the ↓ key until 'CONTINUE' is highlighted then press **READ** to store the settings and return to the measurement page.

You are now ready to calibrate the unit.

Please see the next page for the step by step guide...

One-Point Calibration Continued...

1. Place the Sonde into a beaker containing 20-50ml of MultiCal 1 solution. Stir the solution with the Sonde, leave the Sonde to stand in the solution and press **CAL**.
2. Press **N** to start the Calibration.
3. When the N display is automatically set to 50ppm press the **K** button.
4. When the K display is automatically set to 50ppm press the **P** button.
5. The display will stabilise and set the P display to 10ppm. Note you do not need P Reagent A or B to perform a calibration.



6. Remove the Sonde from the Multi Cal 1 Standard. Rinse with deionised water and dab off the excess solution from the Sonde with a tissue.

You are now ready to measure a sample.

Maintenance and Storage

The Sonde comprises three ISEs and a Reference Electrode. These have their designated slots as indicated on the sensor body.

Each individual sensor can be removed by twisting and pulling the ISE from the Sonde Hub. It is recommended that you remove the Reference Sensor first as this is the easiest to detach. After that the probes are easier to access.

Each ISE is colour coded as follows:

N Sensor	Green
P Sensor	Grey
K Sensor	Red
Reference	Black



Cleaning & Storage

After a measurement session rinse the Sonde with deionised water and dab dry with a tissue or lint free cloth. Replace the small back boot on the tip of the reference electrode (this does not need to be pushed all the way on) and screw on the protective sheath.

The Sonde is kept dry. Do not store for long periods in solutions or deionised water. This will reduce the sensors lifetime.

After long term storage make sure to follow the conditioning step when guided by the NPK Meter.



Maintenance

Each sensor is different and have slightly different cleaning procedures:

The N (Green) and K (Red) Sensors are PVC based and should be rinsed in deionised water and dabbed dry. If the probes are sluggish and look slightly cloudy you can swish in warm water and detergent solution, rinse and leave to stand in the MultiCal 1 Standard for around 20 minutes. Rinse with deionised water and dab dry. Store Dry



The P (Grey) Sensor is a hard crystal and can be physically cleaned with a cloth and then wiped over with IPA or Methanol using a cotton bud. The probe is then rinsed with deionised water and left to stand in MultiCal 1 Standard for 20 minutes. Rinse with deionised water and dab dry. Store Dry



The R (black) Reference has a porous Teflon tip. The best maintenance is to leave standing in a MultiCal 1 Standard Solution overnight to dissolve any crystallised salts deposited in the matrix. Rinse with deionised water and dab dry. Store Dry with the Rubber Cap in place.

If there is no improvement the solution can be warmed to speed up the dissolution.



Diagnostics

Each of the sensors have typical or expected mV (offset) values in the calibration solutions. They also have expected sensitivity or slope values which indicate the response to changes in NPK concentrations.

The diagnostic screen:

When the Meter has been calibrated the mV data is stored in the internal memory.

To access this data you must have completed a Calibration. When you are in the Measurement page with 'CALIBRATED' displayed at the top centre of the screen press the ↓ button.

Two values will be displayed for each of the N, P and K parameters.

The top value is the slope. Typical or expected values are as follows:

N	-48 to -60 mv/ decade
P	- 45 to -74 mV / decade
K	50 to 60 mV / decade

The bottom value is the offset mV value. These have quite a wide range as sensors are made individually. Typical or expected values are as follows:

N	250 to 380mV
P	-410 to -510 mV
K	280 to 390 mV

The offset values will tell you if the sensor is connected and is giving a broadly expected signal.

The slope value is more useful as it confirms that the sensor is responding to changes in the Ion concentration.

If the slopes are below the typical values shown you should try the steps indicated in the maintenance section. If they do not improve you should consider replacing them.

If the slopes have the wrong sign e.g. the N slope is positive there are two causes:

1. The Sensor is connected to the wrong port in the Sonde. Check the colour coding as follows:

N Sensor	Green
P Sensor	Grey
K Sensor	Red
Reference	Black

2. You have calibrated using MultiCal Solution 2 first rather than MultiCal 1.

Using the mV mode

You can check the mV values by putting the Meter into the mV mode. To do this follow steps highlighted in the Setting the Parameters section. When you are in the 'PARAMETER ADJUST' screen scroll down to 'Units' and press **READ** to select mV.

The meter will revert to the measure or calibrate screen. With the Sonde in the MultiCal 1 Standard press **READ**.

The mV value for N in the solution will be displayed. Once stable press the K button and note the K reading.

Use the values given above to diagnose any issues with the Sonde as described.

Unstable Readings

When calibrating or measuring a sample the 'Auto End Point' function will be activated. The mv change per second will be monitored and when the change meets the stability criteria the reading will be frozen and the 'STABLE' indicator will be displayed.

"Parameter Ion lo res unstable" will be displayed until the stable state is reached. This is not a fault indicator but merely shows that the stable state is yet to be reached.

Overriding the Auto End Point Feature

If you are happy that the result is stable and wish to save some time during the measurement or calibration you can simple press **READ**.

The display will be frozen and the result displayed. During Calibration the display will progress to the next stage as if the calibration had been stopped by the 'Auto End Point' function.

Support:

EDT directION offer technical support and advice. Take a look at our support page or watch our instructive Videos on EDT TV our YouTube Channel.



NPK Calibration Video



NPK Meter Kit



EDT TV

