

VWread User Manual





What's this manual about?

This manual tells you about the VWread and how to use it to take readings from VW sensors.

Who does this apply to?

Installers, field engineers and technicians who need to acquire readings from VW sensors and to maintain the VWread system.

Welcome!

Thank you for choosing the VWread.

This manual has been written to help you utilise all of the functions of the VWread. Please read this manual thoroughly before use to help avoid any problems and keep it handy when using the VWread.

VWread

The VWread is a handheld device which takes readings from Vibrating Wire (VW) sensors. The VWread can read almost all commercially available vibrating wire sensors.

Built with state-of-the-art electronic components and the latest firmware, each VWread comes with many powerful built-in functions. These functions will allow you to customise how readings from each sensor are taken and displayed in order to assure correct and repeatable readings every time.

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OVERVIEW & INTRODUCTION

Important information

The following symbols are used throughout the manual



IMPORTANT
INFORMATION



QUESTION



WARNING



TIP



! Important: Failure to adhere to the warnings in this manual may result in network disruption and possible data loss.

Failure to observe the warning may result in injury, product malfunction, unexpected readings or damage to the product that may invalidate its warranty.



Tips give additional information that may be helpful when using VWread.


PRODUCT CHANGES

Soil Instruments has an on-going policy of design review and reserves the right to amend the design of their product and this instruction manual without notice.

WARRANTY

Refer to our terms and conditions of sale for warranty information. The batteries are a consumable item and are excluded from the warranty.

DISPOSAL

Products marked with the  symbol are subject to the following disposal rules in European countries:

- This product is designated for separate collection at an appropriate collection point
- Do not dispose of as household waste
- For more information, contact Soil Instruments or the local authority in charge of waste management.

System Description

Things You Need to Know About VWread

FEATURES

- Portable and rugged
- Compatible with most commonly used VW sensors
- Realtime display of VW sensor readings in Hz, Hz²/1000 and period units
- Fully configurable reading and displaying parameters of each sensor
- Powered by a Nickel Metal Hydride (NiMH) rechargeable battery, 30 hours without backlight and 15 hours with backlight. User selectable backlight for the display, auto shutdown after five minutes of inactivity.

BENEFITS

- Powerful features in a rugged and portable package; makes it easy to carry and operate in all site conditions
- Easy to follow menu makes taking readings on site simple, fast and error free
- The optional 15 VDC excitation, which provides higher energy excitation than the default excitation of 5 VDC, ensures quality readings for sensors with long cables.

System Components

THE VWREAD

The VWread is a handheld readout unit for VW sensors. Below is a picture of the VWread showing the various parts that you will use to interact with it.



VW SENSOR LEAD The VW sensor lead is shown in the picture below. One end of the lead has a Lemo plug that you will plug into the sensor connector on the top left of the VWread. On the other end of the lead are four crocodile connectors coloured red, black, green and white, for connecting to the wires in the signal cable of a sensor with matching colours.



RECHARGEABLE BATTERY & CHARGER The VWread contains a Nickel Metal Hydride (NiMH) rechargeable battery and is supplied with a Smart battery charger.



VWREAD CARRY CASE The VWread is supplied with a padded carry case with shoulder strap and pockets for the sensor connecting lead. We recommend that you carry and store the VWread in the carry case whenever it is not being used.



Quick Start Guide

BEFORE YOU GO TO SITE:

1. Remove the VWread from its carry case and place it on charge, ensuring that you follow the charging procedure outlined in *Detailed VWread User Guide - Charging the VWread*.
2. Switch on the VWread.
3. Familiarise yourself with the reading function below:
 - Connect a VW sensor to the VWread using the sensor lead
 - Go to '**Main Menu...**', 1) **Read Sensor**'
 - Press the → to read the sensor
 - Check the VW reading and the temperature reading.



Follow the troubleshooting guide in *Appendix B* of this manual if the readings are unstable or incorrect.

4. Switch off the VWread by selecting '**Main Menu...**', 5) **Turn Off**' then press the → key.
5. Unplug the sensor lead from the VWread. Replace the sensor connector cap.
6. Place the VWread in its carry case along with the sensor lead ready to take to site.



VWread will automatically turn itself off after 5 minutes of not being used to save battery power.

WHEN YOU ARE IN THE FIELD:

1. Remove the VWread from its carry case.
2. Switch on the VWread and follow the procedures below to take a reading:
 - Connect a VW sensor to the VWread using the sensor lead
 - Go to '**Main Menu...**', 1) **Read Sensor**'
 - Press the → to read the sensor
 - Make a note of the VW reading and temperature reading if required
 - Disconnect the sensor cable from the crocodile clips.

DETAILED VWread USER GUIDE

Charging The VWread

The VWread is supplied with a Nickel Metal Hydride (NiMH) rechargeable battery. It is important to follow the charging procedure outlined below at all times to correctly maintain the battery.

STEP	ACTION
1	Make sure the VWread is switched off
2	Remove the protective cap from the charging point, located on the top of the VWread
3	Plug the connector into the charging point on the VWread
4	Plug the charging unit into a mains power socket
5	Switch on the mains power to the charging unit
6	The LED on the charging unit will follow the sequence outlined in the table below
7	Place the protective cap back into the charging point on the VWread when charging is complete

CHARGING UNIT LED SEQUENCE

STEP	LED	STATUS
1	Red - Green	Analysing battery status
2	Red - Green	
3	Red	Charging in progress
4	Green	VWread charged; switched to trickle charge mode



Follow the charging procedure outlined in this manual at all times to properly maintain the VWread.

Connecting Sensors to the VWread

You can connect only one Vibrating Wire sensor at a time to the VWread; this sensor can be with or without a built-in temperature sensor.

VW SENSOR WITH BUILT-IN TEMPERATURE SENSOR

All sensor connections to the VWread are made via the Lemo plug which is located under a cap on the top of the VWread, as shown in the figure below:



CLIP COLOUR	SENSOR TERMINAL
Red	VW +
Black	VW -
Green (or Blue)	Temperature +
White	Temperature -

Consult the sensor user manual for the sensor connections. If you are still unsure, please contact Soil Instruments.

Please ensure that the bare parts of the clips do not touch each other and cause shorts among the four wires.



VWread is only compatible with NTC 3k Ω thermistor temperature sensors. It will not work with RTD-based temperature sensors in some Manufacturers VW sensors.

VW SENSOR WITHOUT BUILT-IN TEMPERATURE SENSOR

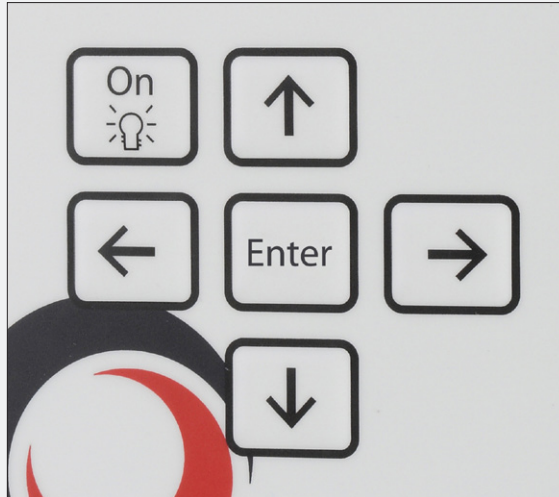
For a VW sensor without built-in temperature sensor, only connect the sensor to the red and the black crocodile clips.



Only a qualified person trained in the use of VWread and the VW sensors may connect sensors.

How To Use The Keypad

Below is a picture showing the keypad of the VWread. Each key on the keypad has multiple functions depending on its context within the VWread menu.



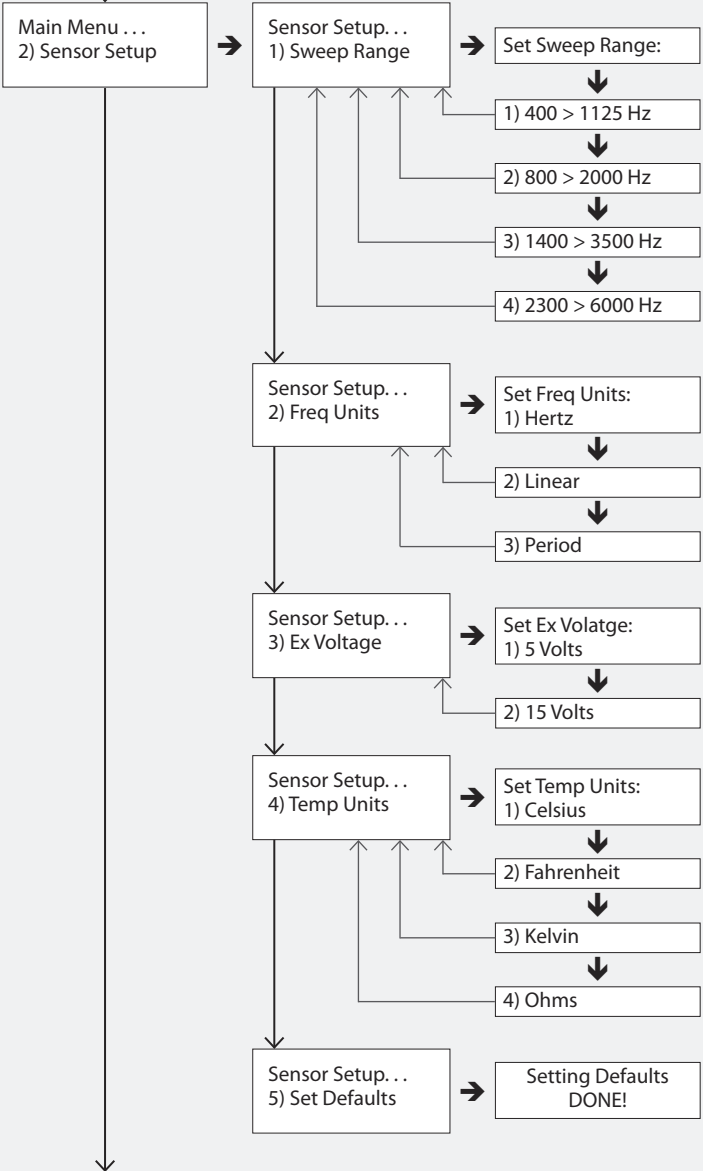
KEY	FUNCTION
[On]	The [On] button has two functions: <ol style="list-style-type: none">1. When the VWread is off, pressing it turns the VWread on.2. When the VWread is already on, pressing it will toggle the LCD displays backlight between on and off.
Up [↑]	The ↑ key acts as an 'up' instruction. It moves the cursor up in the currently displayed list such as the main menu and readings screen.
Up [↓]	The ↓ key acts as a 'down' instruction. It moves the cursor down in the currently displayed list such as the main menu and readings screen.
Left [←]	The ← key acts as a 'back' instruction. When a menu option is selected, pressing this key will take you back to the previous menu selection.
Left [→]	The → acts as a 'next' instruction. Pressing this key will take you to the next menu selection, or confirm a current menu selection.
[Enter]	The [Enter] button acts as a 'select' instruction. Pressing this key will confirm a current menu selection.

Menu Structure

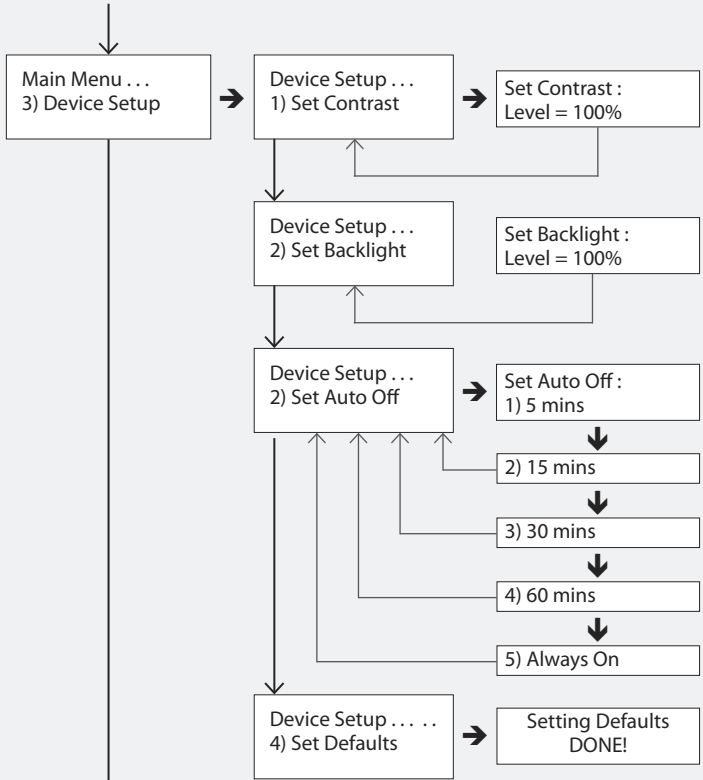
READ SENSOR



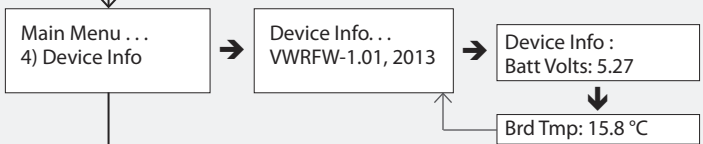
SENSOR SETUP



DEVICE SETUP



DEVICE INFO



TURN OFF



READ SENSOR

Select this menu item to take a reading of the VW sensor that is currently connected to the VWread.

SENSOR SETUP

This option leads to you the sub menus where the sensor setup preferences can be changed to suit your requirements. These menu options are explained further in the following paragraphs.

SWEEP RANGE

Selecting the 'Set Sweep Range' function allows you to choose from four pre-set frequency ranges:

- **400 > 1125 Hz**
- **800 > 2000 Hz**
- **1400 > 3500 Hz**
- **2300 > 6000 Hz**

The suitable frequency range will be dependent on the type of VW instrument you a reading.



Please refer to the manufacturers specifications for the VW Sensor you are reading when setting the sweep range.

FREQ UNITS

This menu gives you three choices of frequency units:

- **Hertz**
- **Linear ($F^2/1000$)**
- **Period ($t \times 10^7$)**

EX VOLTAGE

'Ex Voltage' allows you set the excitation voltage according to the type of VW sensor you are going to read. There are two options available:

- **5 volts**
- **15 volts**

TEMP UNITS

This menu gives you four options of temperature units;

- **Celsius**
- **Fahrenheit**
- **Kelvin**
- **Ohms**

SET DEFAULTS

Once you have set all the preferences to suit your requirements, select the 'Set Defaults' option. All your settings will be saved and confirmed with 'Setting Defaults DONE!'.

DEVICE SETUP

'Device Setup' presents you with a number of options that are specific to the device itself. These options are further explained in the following paragraphs.

SET CONTRAST

This option allows you to set the screen contrast level anywhere from 0 – 100%. The level can be adjusted using the **↑** and **↓** keys.

SET BACKLIGHT

This option allows you to set the backlight level anywhere from 0 – 100%. The level can be adjusted using the **↑** and **↓** keys.

SET AUTO OFF

This function allows you to set the amount of time before the device will automatically turn itself off when not in use.

There are five options available;

- **5mins (recommended setting)**
- **15mins**
- **30 mins**
- **60mins**
- **Always On.**



Choosing the '**Always On**' setting will significantly reduce the amount of battery charge in the device.



The optimum '**Auto Off**' setting for preserving battery charge is 5 minutes.

SET DEFAULTS

Once you have set all the preferences to suit your requirements, select the '**Set Defaults**' option. All your settings will be saved and confirmed with '**Setting Defaults DONE!**'

DEVICE INFO

'Device Info' provides you with the following information;

- **Firmware version, date**
- **Battery Volts**
- **Board Temperature.**

TURN OFF

Selecting '**Turn off**' will turn the unit off, irrespective of the pre-set '**Auto Off**' function.

MAINTENANCE GUIDE

Maintaining The VWread

The VWread is manufactured with a multi-layer circuit board containing surface mount components. For this reason there are no parts which require routine maintenance.

BATTERY MAINTENANCE

The VWread is supplied with a Nickel Metal Hydride (NiMH) rechargeable battery. Although the battery requires no maintenance as such, it is important to follow the charging procedure outlined below at all times to correctly maintain the battery.

As rechargeable battery capacity reduces over time, the VWread battery will be tested and replaced if necessary, during annual re-calibration.

STEP	ACTION
1	Make sure the VWread is switched off
2	Remove the protective cap from the charging point, located on the top of the VWread
3	Plug the connector into the charging point on the VWread
4	Plug the charging unit into a mains power socket
5	Switch on the mains power to the charging unit
6	The LED on the charging unit will follow the sequence outlined in the table below
7	Place the protective cap back into the charging point on the VWread when charging is complete

CHARGING UNIT LED SEQUENCE

STEP	LED	STATUS
1	Red - Green	Analysing battery status
2	Red - Green	
3	Red	Charging in progress
4	Green	VWread charged; switched to trickle charge mode



Follow the charging procedure outlined in this manual at all times to properly maintain the VWread.

BATTERY LIFE

Battery life is a function of a combination of the following factors;

- **Battery type**
- **'Auto Off' settings**
- **How often the VWread is used to take reading**
- **'Contrast' and 'Backlight' settings**
- **How often the backlight is switched on**
- **Ambient temperature.**

In designing the VWread system, Soil Instruments have produced firmware routines to maximise the battery life. As a rule of thumb, the VWread can achieve battery life of up to 30 hours without backlight and 15 hours with the backlight switched on.

To maximise battery life, the VWread has an inbuilt off timer. When the VWread has been inactive for a pre-set time it will automatically turn off.

The battery voltage in the VWread should be above 4.6 volts for the VWread reading circuitry to work. If the voltage goes below 3.6 volts, the VWread will shut off.

CALIBRATION

Each VWread is calibrated before it is shipped. To meet your calibration needs, we offer re-calibration services at our facilities. If you intend shipping the VWread back to our factory, please contact Soil Instruments or our distributors for more information.

APPENDICES

Appendix A – How to apply Calibration Factors for VW Sensors

The calibration certificate for your VW sensor will provide you with the information on how to convert the raw readings into readings in engineering units.

Below is an example of calibration certificate from Soil Instruments:



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 TN22 1QL United Kingdom t: +44 (0) 1825 765044 e: info@soilinstruments.com w: www.soilinstruments.com
 Soil Instruments Limited. Registered in England. Number: 07960087. Registered Office: 3rd Floor, 1 Ashley Road, Altrincham, Cheshire, WA14 2DT, UK

VIBRATING WIRE INSTRUMENTS CALIBRATION CERTIFICATE

Instrument Type : W9 Vibrating Wire Piezometer **Serial No.** : 054883

Instrument Range : 0.00 to 500.0 kPa **Calibration Date** : 05/04/2016

Gauge Factors in kPa **Ambient Temperature** : 24°C

Period Gauge Factor (K): 3268.0610000 **Barometric Pressure** : 1004 mbar

Linear Gauge Factor (G): (kPa/digit)0.3268100 **Calibration Technician** : Wayne Diprose

Polynomial Gauge Factor A: -0.000001316427000 **Calibration Equipment:**
 Mensor APC 600
 AVW200 Data Logger

Polynomial Gauge Factor B: -0.3118874000

Polynomial Gauge Factor C:** 2060.205000 **Regression Zero** : 6432.5

Applied (kPa)	Reading (Period)	Reading F ² /1000	Calculated (Linear)	Error %FS (Linear)	Linear Increment	Calculated (Polynomial)	Error %FS (Polynomial)
0.00	3943.3	6431.0	0.475	0.10	0.0	0.013	0.00
50.00	3990.8	6279.0	50.150	0.03	-152.0	49.963	-0.01
100.00	4040.1	6126.4	100.020	0.00	-152.6	100.049	0.01
150.00	4091.3	5974.1	149.793	-0.04	-152.3	149.976	0.00
200.00	4144.6	5821.4	199.696	-0.06	-152.7	199.972	-0.01
250.00	4200.3	5668.2	249.763	-0.05	-153.2	250.071	0.01
300.00	4258.0	5515.6	299.634	-0.07	-152.6	299.911	-0.02
350.00	4318.5	5362.0	349.831	-0.03	-153.6	350.017	0.00
400.00	4381.8	5208.4	400.028	0.01	-153.6	400.060	0.01
450.00	4447.7	5055.0	450.160	0.03	-153.4	449.976	0.00
500.00	4517.0	4901.1	500.456	0.09	-153.9	499.993	0.00

Formulae: Linear* E = G(R0 - R1)
 Polynomial** E = AR1² + BR1 + C

* The zero reading should be established on site by the user on installation.
 ** The site value of C must be calculated using the formula C = -(AR0² + BR0)

The instrument detailed hereon has, as applicable, been tested and calibrated in accordance with procedures, which are part of our ISO 9001:2008 Quality Management System, and unless otherwise indicated, performs within ± 0.10% (Polynomial) as specified. Thus, the instrument conforms in all respects to our relevant specifications and drawings.

Certified:  Line MANAGER

Calculation of Engineering Units From Frequency Readings of VW Sensors

The mathematical relationship between the resonance frequency of a tensioned wire and the force applying the tension is represented by a near straight line relationship between the square of the frequency (Hz^2) and the applied force.

The sensor readings in frequency can be converted to measurements in engineering units (such as mm, kPa or psi) using the following equations:

CALCULATION USING LINEAR EQUATION

The following equation is used for readings in $\text{Hz}^2/1000$:

$$E = G \times (R_0 - R_1)$$

where:

E is the resultant Engineering unit

G is the linear Gauge factor for the units of calibration

R₀ is the 'base' or 'zero' reading (in $\text{Hz}^2/1000$) taken at the time of installation

R₁ is the current reading in $\text{Hz}^2/1000$.

CALCULATION USING POLYNOMIAL EQUATION

The polynomial formula for all Soil Instruments' VW sensors is:

$$E = A \times R_1^2 + B \times R_1 + C$$

where:

E is the resultant value in Engineering units

A, **B** and **C** are the polynomial factors from the calibration sheet

R₁ is the current reading in $\text{Hz}^2/1000$

It should be noted that **C** is an offset value derived from a 'base' reading in the factory where the sensor calibration is performed. Soil Instruments recommend the value for **C** should be recalculated at the time of installation from the **R₀** as follows:

$$C = - (A \times R_0^2 + B \times R_0)$$

Appendix B – Frequently Asked Questions



What happens if I drop the VWread unit?

The VWread is resistant to a drop from one metre onto a concrete surface. The VWread is supplied with a wrist strap so you can keep it attached to your wrist when in use. Please make use of it to avoid accidental damage.

What do I do if my reading is unstable?

Check that the crocodile clips are correctly connected to the sensor.

Why am I getting a display of “VW: No Sensor?” or “TH: No Sensor?”?

This means no VW sensor and/or no thermistor sensor is connected, or the sensor or the signal cable is faulty. Check the sensor lead is properly connected and then check the signal cable and the sensors.

Will VWread work at very low or very high temperatures?

The VWread was tested and working after it had been in a temperature chamber for an hour at -10°C . At temperatures lower than -10°C , the LCD screen may become unreadable. The same test was conducted at $+50^{\circ}\text{C}$ and the VWread functioned normally.

Appendix C – CE Declaration



EC Declaration of Conformity

Soil Instruments Ltd., located at 34 Bell Lane, Uckfield, East Sussex, TN22, 1QL, United Kingdom.

We hereby declare that the devices described below are in conformity with the directives listed. In the event of unauthorised modification of any devices listed below, this declaration becomes invalid.

Type: VW-Note and VW-Read

Product Model: RO-1 VW Note and RO-1 VW Read

Relevant EC Directives and Harmonized Standards:

2004/108/EC Electromagnetic Compatibility directive, as amended by **EN61326-1, ed3**

The product(s) to which this declaration relates is in conformity with the essential protection requirements of 2004/108/EC Electromagnetic Compatibility directive, as amended by EN61326-1, ed3. The products are in conformity with the following standards and/or other normative documents:

EMC: Harmonized Standards: EN 61326-1:2006 Lab Equipment, EMC

IEC61000-6-3:2007 Emission standard for residential, commercial and light-industrial environments

IEC61000-4-2:2008 Electrostatic discharge immunity test

IEC61000-4-3:2006 Radiated, radio-frequency, electromagnetic field immunity test

IEC61000-4-4:2012 Electrical fast transient/burst immunity test

IEC61000-4-5:2005 Surge immunity test

IEC61000-4-6: 2008 Immunity to conducted disturbances, induced by radio-frequency fields

IEC61000-4-11:2004 Voltage dips, short interruptions and voltage variations immunity tests

I hereby declare that the equipment named above has been designed to comply with the relevant sections of the above referenced specifications. The items comply with all applicable Essential Requirements of the Directives.

Philip Day

A handwritten signature in black ink, appearing to read "Philip Day", is written over a horizontal line.

Date: 05 June 2017

Manufacturing Manager,

Issued in: Bell Lane, Uckfield, East Sussex, TN22, 1QL, United Kingdom

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