INSTALLATION MANUAL

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Warning EMC Compatibility.

The installation of the following equipment must be installed in accordance with the following instructions detailed in this manual or EMC may be violated.

1. GENERAL DESCRIPTION OF THE SYSTEM.

The WSDA sensor head incorporates a combination of wind speed and wind direction sensors and is manufactured in clear anodised (HT30) aluminium alloy.

The Wind Speed component consists of a low-inertia ABS cup assembly for fast response, mounted on a dual ballrace-supported stainless steel shaft. The use of a Bremag 10 magnet operating a long life mercury-wetted reed switch produces one bounce-free pulse per revolution of the rotor.

The Wind Direction component consists of a dynamically balanced wind vane operating a triple ballrace supported shaft and micro-torque 357^{o} potentiometer with a deadband of 3^{o} at North. With the above designs, most modern loggers can be connected to these sensors with little or no interfacing. An additional benefit is the zero power requirement.

Various possibilities exist for mounting the WSDM sensor head and a length of 8 mm stainless steel studding is supplied for this purpose. However, two systems are recommended; the full mast kit WSDM or the bracket kit WSDB. See the relevant sections within this manual for further details on the assembly and use of the above.

For OEM use, special mountings could be made to suit if required, dependent on demand. Please contact Automatikprodukter to discuss your exact requirements.

The dimensions of the WSDA sensor head are:

Height : 280 mm

Max arc: 120 mm

Weight : 500 gms approx.

1.1 Choosing a site.

The site chosen to install the WSDA sensor head will depend in part on the application to which it is being put and in part on the particular circumstances at the site. If the application is very specific, such as monitoring wind speeds on a bridge, then the siting of the head is largely prescribed by use. However, even then, some precautions need to be taken. These are largely self-evident but often overlooked.

Firstly, a site should be chosen which is as representative as possible of the area to be monitored . Circumstances may limit choice, but extremes should be avoided when possible, unless of course, it is desired to measure the weather at these particular, extreme sites. For example, sites on the top of hills, however small, will give increased windspeeds, while in valleys and small hollows the reverse will also be the case. Too close proximity to buildings or trees will also affect readings, due to their shielding properties, while deployment actually on a building (flat roof or wall) is particularly bad due to the obstruction of wind-flow, causing turbulence and eddies. Because windspeed increases logarithmically with height above the ground for the first 20 metres (but less thereafter), exposure on a tall mast will give higher windspeeds. Two metres is the most usual height adopted, although the UK Meteorological Office standard is 9 metres.

It should also be remembered that all weather characteristics are spatially variable, even over quite short distances. Extrapolating the wind readings to distances well beyond the position of the sensor may not, therefore, be justifiable; however, with the low cost of the WSDA, and the use of a multi-channel logger, several heads could be installed over an area, giving a better spatial coverage and a more precise estimate of an area's wind characteristics. Highly precise measurements made at just one point may well be a waste of money due to spatial variability.

Vandalism can be a problem. However, if a fence is built around the station, it should not be too close and should be of fairly open construction. Due to the compact and lightweight design of the WSDA head, however, it can easily be installed high enough to be out of reach. This may be sufficient to prevent interference.

2. WIRING AND CONNECTION INFORMATION.

This section gives information on connecting the WSDA to loggers, including a circuit diagram. For details on connecting the WSDA to specific loggers, please see list of additional data sheets. If extended cables are being used then ensure that the relevant technical information has been read in Section 3 of this manual.

2.1 Wiring colours.

The cable supplied with the WSDA sensor head consists of three twisted pairs of inner conductors plus a screen. The screen is NOT connected within the head. A pair of conductors consists of one colour plus it's associated black. This means that there are thus three blacks within the cable, and care must be taken to ensure that the user does not confuse these. To help in this regard each conductor has been labeled with a heat shrink marker. The labels used are shown in Table 1 .

Table 1. Details of wiring colours.

COLOUR	LABEL	CONDUCTOR USE
GREEN	1	REED switch via 100R resistor.
BLACK	2	REED switch
WHITE	3	POTENTIOMETER (T1) usually excited via a resistor
BLACK	4	POTENTIOMETER (T3) usually to excitation GND
RED	5	WIPER of POTENTIOMETER (T2) usually to analogue HI
BLACK	6	POTENTIOMETER (T3) usually to analogue LO (GND)

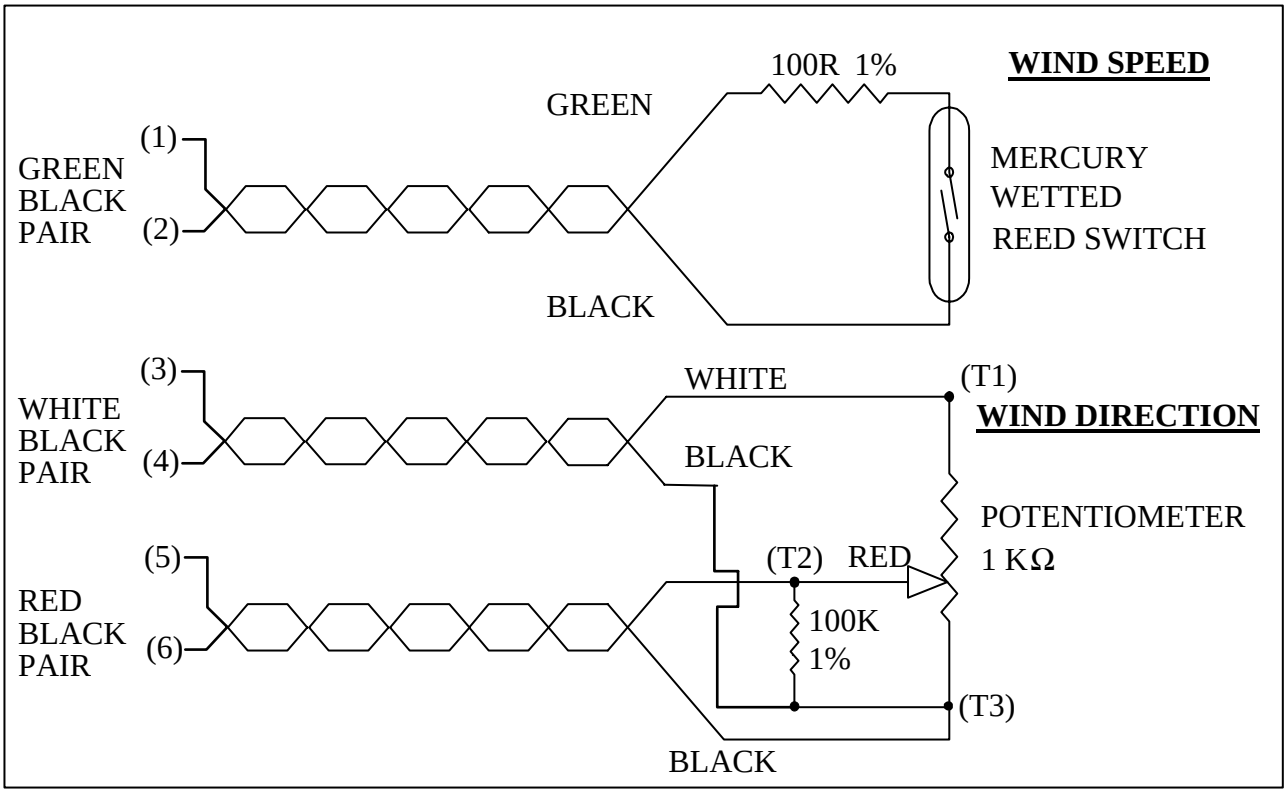

Figure 1. WIRING DIAGRAM OF WSDA.

3. ADDITIONAL TECHNICAL INFORMATION.

This section gives a greater amount of information of a technical nature relating to the WSDA sensor head, including information relating to the cable which is connected. This is relevant if the cable is extended, which is quite common when the head has to be mounted in high positions or the logging/display unit is to be positioned some distance from the head.

3.1 Technical specifications.

3.1.1 Speed Sensor:

This is a magnet-operated mercury wetted reed switch giving a bounce free 1 pulse per revolution of the anemometer cups.

Calibration:	1 contact closure/1.493 m.
Reed detector:	Bench tested to a minimum speed of 90 m/s.
Start up[1] :	0.5 m/s typically.
Accuracy:	2%
Linearity:	2%
Contact rating:	50 Watts. (d.c. resistive)
Supply:	
Voltage	100 Vdc maximum
Current	1 A maximum.

Note: These are contact maximum ratings. The product of the voltage and current that is switched must not exceed the maximum wattage rating of the contacts (50 Watts).

The use of this design also allows the anemometer to be used in circuits down to zero voltage and current, without reducing the life expectancy of the reed switch.

It will be noticed in the circuit diagram (Figure 1) that a 100 ohm resistor is fitted into the wiring. This is because in long cable runs the capacitance between conductors is appreciable. When the switch closes the capacitance is discharged across the contacts; without the resistor fitted this could lead not only to shortening of switch life but also to the generation of transients within the other wires. Although only needed in longer cable runs, this resistor is fitted as standard within the WSDA head.

[1] Start-up is defined as the speed required to commence the movement of the cups from a standstill in zero wind. However, in practice an anemometer rarely stops and very low wind-speeds are able to be detected due to the low-inertia cup assembly.

3.1.2 Direction sensor:

This is a low-torque 1 Kohm potentiometer design using a 3 mm shaft and associated bearings (3 off).
The vane is of a balanced design.

Mechanical travel:	360° (Endless)
Electrical travel:	357° ±2°
Calibration:	0-1Kohm potentiometer for 0-357° electrical travel.
Resistance tolerance:	±3%
Linearity tolerance:	±0.5%
Temperature Coefficient of wire:	±20 ppm/°C
Temperature range:	-20...+70°C
Supply Voltage Max[1]:	80 Vdc
Recommended Max. Voltage:	24 Vdc

It will be noticed in the circuit diagram (Figure 1) that a 100 Kohm pull down resistor is fitted into the wiring within the head. This is fitted to effectively remove the gap at north by tying the wiper (T2) to the low terminal (T3). The analogue inputs on some loggers will float giving odd readings when there is no input; this value of resistor should eliminate this. Linearity is slightly affected; however this is only 0.01% which can usually be ignored due to the potentiometer's ±0.5% linearity.

3.1.3 General cable information.

Cable supplied as standard is 3 metres in length and may be shortened or lengthened as required. If the cable is lengthened, please ensure a good quality environmental connector, or suitable waterproof junction box, is used. Extension cables used must be of a similar specification; however, separate cables for the speed and the direction components could be run.

3.1.4 Cable technical information.

The cable sheathing is of halogen-free polyolefin, which is flame retardant to BS 4066 and IEC 322 Part 3.
The conductors are 7/0.2 mm (24awg) stranded tinned copper, polyolefin insulated twisted pairs (3 pairs).
A similar size drain wire is included with overall foil wrap screen.

Operating temperature:	-25...+75°C
Overall dia.:	6.0 mm
Char. impedance:	85 ohm
Capacitance/metre:	108 pF

Equivalents:

Brand Rex	HF57503	Belden	9503	UL style	2464

[1]To use voltages higher than the RECOMMENDED MAXIMUM, then a series limiting resistor must be included within the circuit. If this is not done then a very effective HEATER will be produced!

3.1.5 Long cable runs on the WSDA.

As mentioned in the Speed Sensor section there are no problems when long cable runs are used. However, with the Direction Sensor the situation is different, in that the longer the cable is, the longer the signal rise time and the longer it is before the input has settled. This error is greater for the larger angles of wind direction. If the logger allows for this (for example, as Campbell Scientific CR10 or 21X loggers do) then use a delay to eliminate this; 10 m/s is usually enough for virtually all situations but this does depend on the logger used.

Users beware !

For users who are new to wind monitoring, a word of advice may be useful. If a simple averaging system is used on wind-direction a problem arises around the North direction.

Example: If 357^{o} equals a 2 Vdc full scale reading and 0^{o} equals a 0 Vdc output.

Then, if the wind is hovering either side of North, and a number of readings are obtained. Some would be around 2 Vdc and some around 0 Vdc. If these were now averaged a result of around 1 Vdc would be obtained, equivilent to South.

To get over this problem, it is necessary to use a vectoring system to produce the correct results.

3.2 List of connection information sheets.

For users that require further technical information on the connection of the WSDA head to specific loggers, Environmental Measurements can supply further information in the form of data sheets. These can be posted or faxed to the user if required free of charge.

Order code	Logger(s) covered.
WSDCAM.001	Campbell Scientific CR10, 21X.

4. ASSEMBLY AND USE OF THE WSDM KIT.

The kit consists of the WSDA sensor head plus a full mast kit for mounting the head at the standard two metres height. It is of a lightweight all aluminium construction and suitable for temporary or permanent use. All the alloy parts are black anodised with the exception of the elbow, this being clear anodised. Stainless steel screws are used throughout.

4.1 Basic assembly

Unpack and identify all parts of the WSDM kit from the box by using Figures 2, 3 and 4 and Table 2.

The assembly instructions will refer to the item letters contained in Table 2.

Table 2. Contents list of WSDM kit.

Item	No. off	Description
a	1	WSDA head
b	1	elbow mount
c	1	mast adaptor
d	1	mast (2 sections)
e	1	mast joiner
f	1	base-plate + 4 pegs
g	1	guy wires kit.
h	1	screws kit.
j	10	wire ties
k	3	stakes

4.2 Lower mast assembly.

The mast is supplied part assembled, and requires swinging the lower tube (d1) of the mast through 90^{o} to be vertical to the baseplate (f).
Place a washer onto the M6 bolt and slide bolt through holes in baseplate (f) and lower tube (d1), then fit the washer and nut.
Screw six M4 set-screws into the threaded holes of the mast joiner (e). Ensure the set-screws do not protrude into the inside of the joiner (e).

4.3 Upper mast assembly.

The upper mast also comes part assembled, having the mast adaptor (c) pre-fitted. Screw six M4 set-screws into the threaded holes of the mast adaptor (c). Three of these screws are fitted through the upper end of the tube (d2). Ensure the set-screws do not protrude into the inside of the joiner (c). The guy-wires (g) again are supplied preassembled and should now be fitted to the mast. Remove one of the M6 screws from the mast, fit the small plate on the end of a guy-wire (g) over the screw and replace the screw. Repeat for the other two guy-wires.

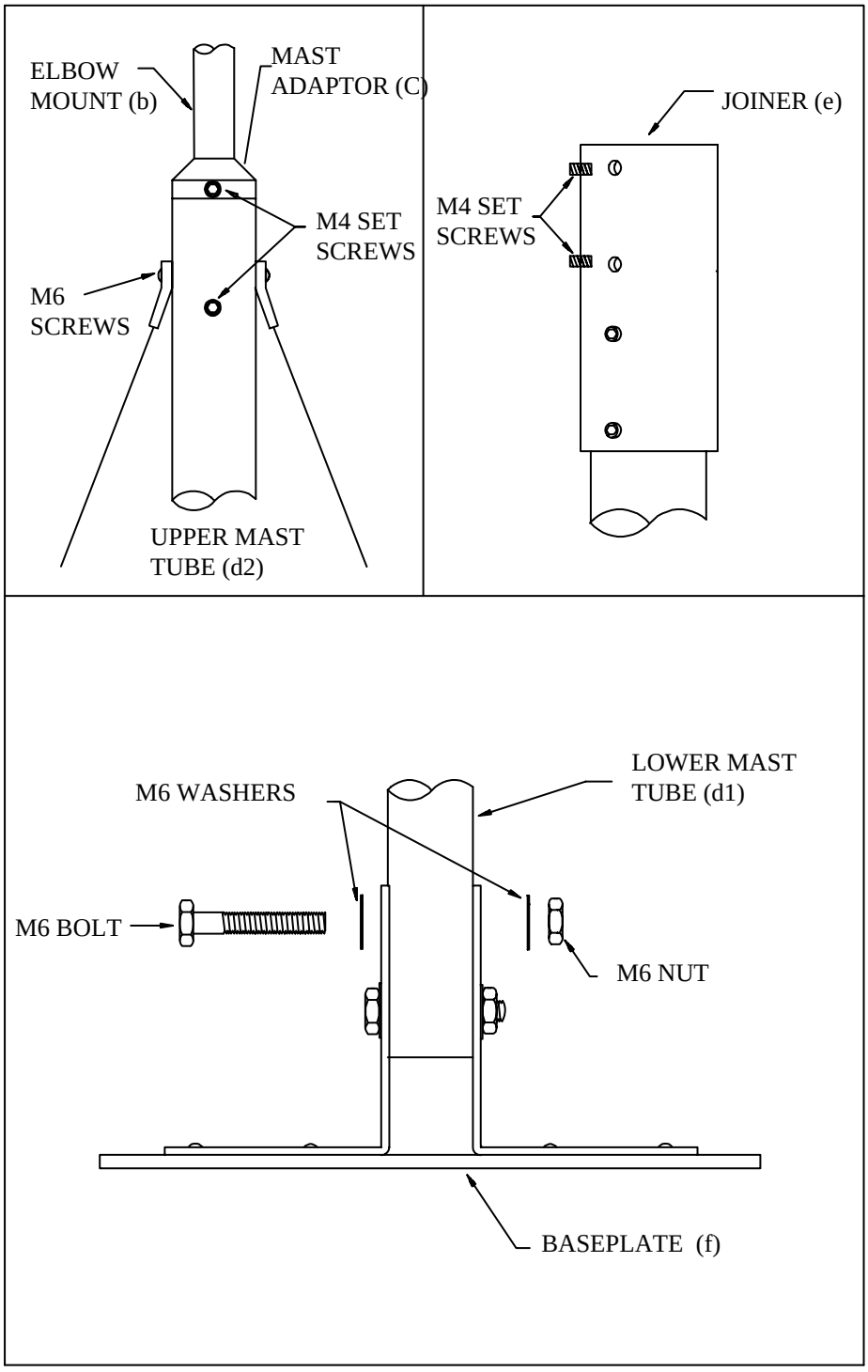

Figure 2 MAST ASSEMBLY IN DETAIL

4.4 Final assembly.

If the system is being assembled in the field then the four steel pegs are now fitted through the corners of the Baseplate (f) and into the ground. They may require a little persuasion with a mallet.
Assemble an M6 bolt and washer through the hole in a stake (k), fit another washer and then the first shoulder nut as shown in Figure 3, and fully tighten. Repeat for the other two stakes.
Place the upper-mast assembly into the mast joiner (e) and tighten the six M4 set-screws.

Again, if this is in the field, then, while keeping the mast near vertical it is necessary to position the three stakes (k) to be equispaced around the mast, while at the same time ensuring the distance from the mast will suit the guys.

When the position is correct, drive the stakes into the ground using a mallet.
Fit the ring end of the guy adjusters over the original shoulder nut and then fit another shoulder nut and tighten. Repeat for the other two stakes.
Ensure mast is vertical by using a spirit level against mast and turn adjusters to set this. Tighten the adjuster's locknuts.
Screw the M8 stud of the WSDA (a) head into the threaded end of the elbow (b) and then place end of elbow (b) into the top of mast.

4.5 Alignment.

Using a compass the elbow of the mast must be aligned to point to the north (See Figure 4 for explanation).
This method is usually accurate enough ($\pm 5^{o}$); however, for better accuracy then an alternative is to lightly hold the windvane pointing in the direction of North and rotate the elbow until North is displayed on the real-time display of the logger/display unit. This will obviously depend upon the logger used.
The easiest method of all relies on the logger firstly using a vectoring method of averaging and secondly being able to accept an offset of the resulting answer to be programmed in.

After aligning, tighten the six M4 set-screws to stop the elbow (b) from rotating. The cable ties should be fitted to ensure a tidy cable run down the mast. Try to keep the cable following around the outside bend of the elbow, to present as clean a profile to the wind vane as possible. Also note that flapping of cables in the wind is a very common source of sensor failures.

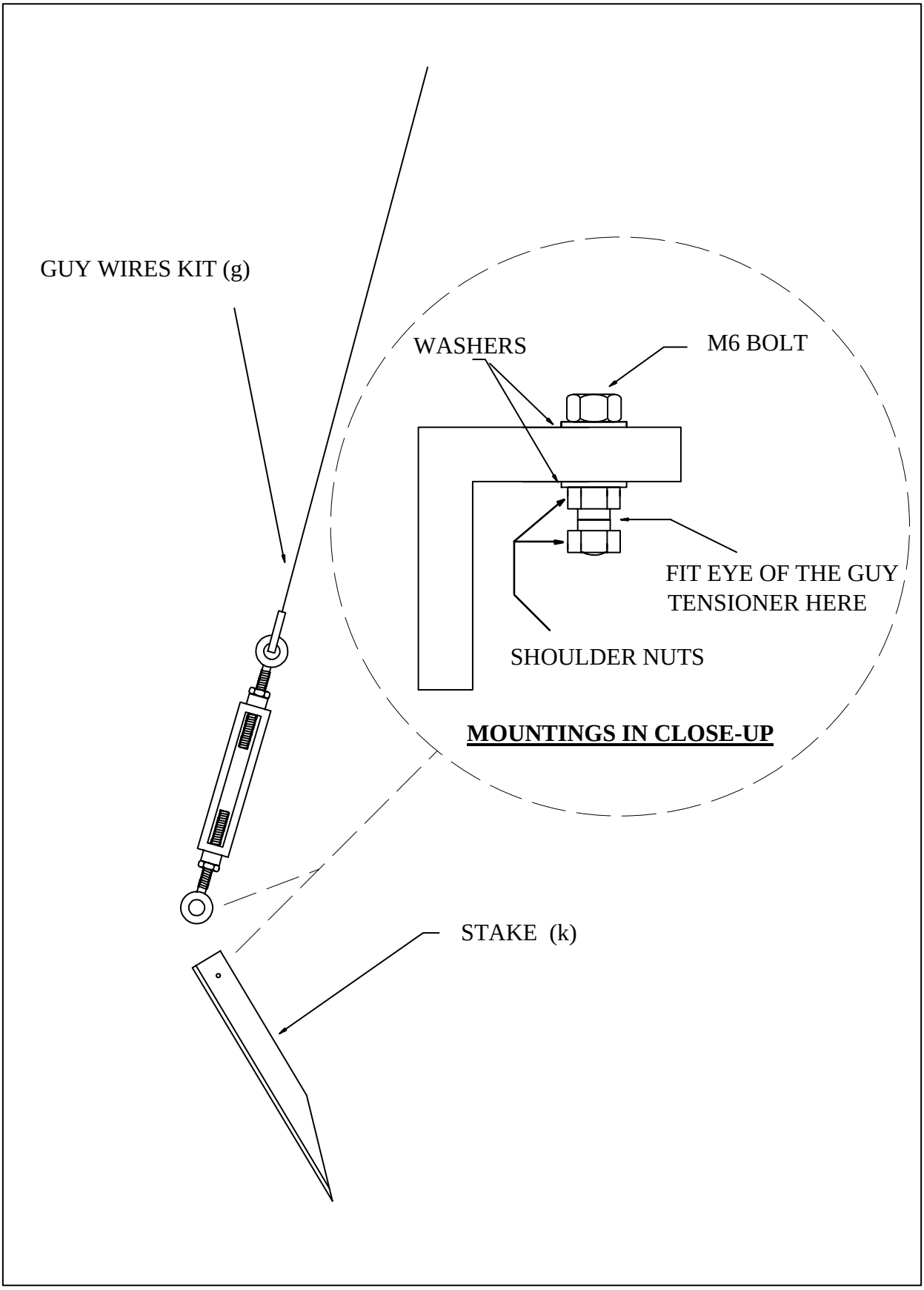

Figure 3. GUY WIRES IN DETAIL

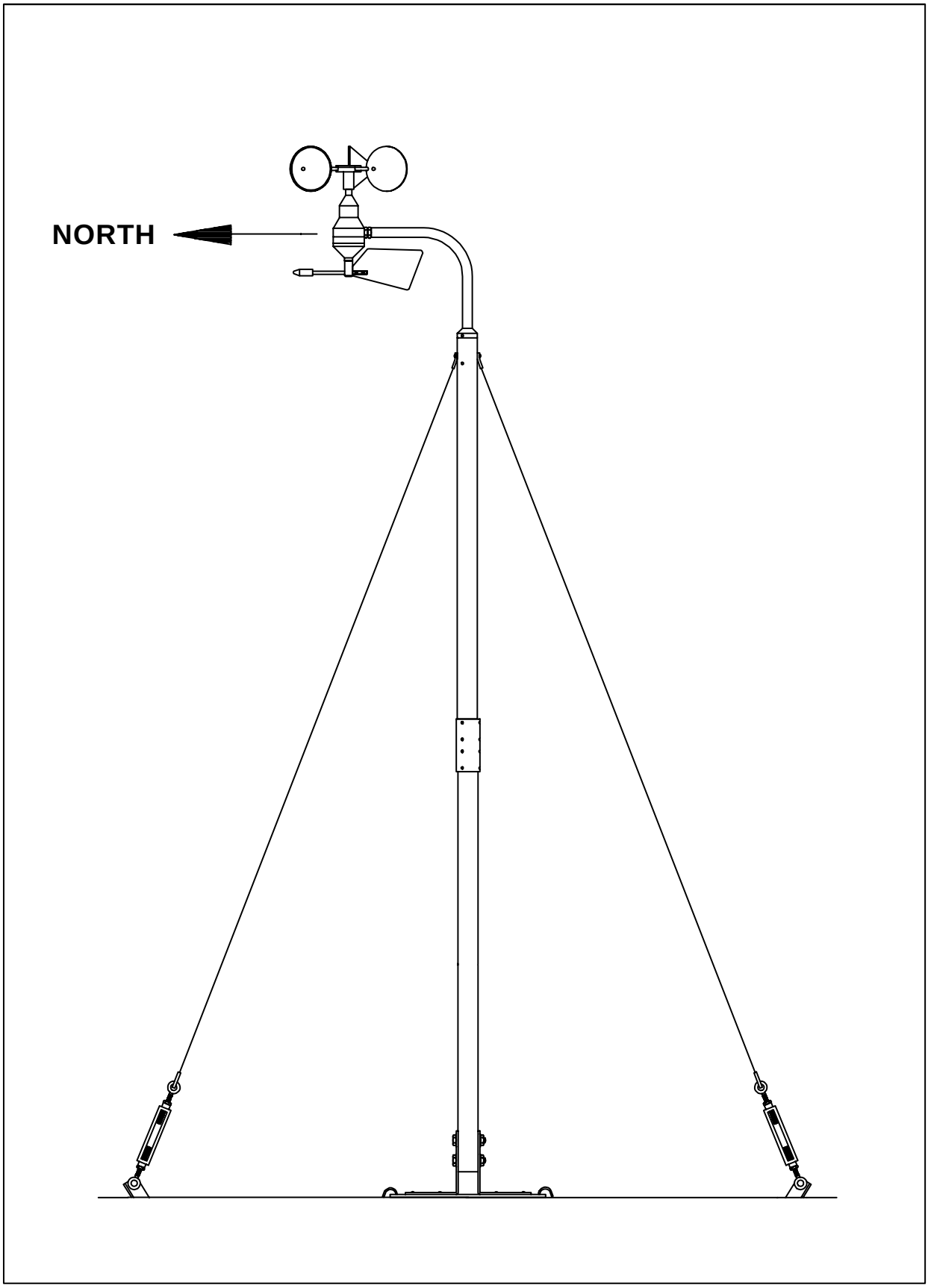

Figure 4 THE ASSEMBLED WSDM KIT

5. ASSEMBLY AND USE OF THE WSDB KIT.

The WSDM kit consists of the WSDA sensor head plus a simpler mounting than the WSDM kit, used when fixing to masts or poles of up to 50 mm in diameter. The mounting is of an all clear anodised alloy construction.

5.1 Unpacking and Assembly.

Unpack and identify all parts of the WSDB kit from the box by using Figure 5 and Table 3.
All of the assembly will refer to the item letters contained in Table 3.

Table 3. Contents list of WSDB kit.

Item	No. off	Description
a	1	WSDA head
b	1	elbow mount
c	1	bracket plate
d	2	U-bolts,nuts,washers
e	2	M6 bolts,washers
f	10	wire ties

Assembly consists of fitting the two washers to the M6 bolts (e) and passing the bolts through the bracket plate (c) and screwing them into the threaded holes of the elbow mount (b). Do not over tighten.

Screw the M8 stud of the WSDA head into the threaded end of the elbow mount (b), and while keeping the WSDA head perpendicular to the elbow mount (b) tighten the locknut to fix the WSDA head in position.

The U-bolts (d) are now fitted through the bracket plate (c) and the nuts and washers fitted. This completes the assembly.

5.2 Fitting to a mast.

This completed assembly is simply fitted by slackening or removing the U-clamps and placing the V-section against the chosen mast; then replace the clamps.

5.3 Alignment.

Before tightening the clamps, use a compass to ensure the elbow mount is aligned to the north (See Figure 5 for explanation). This method is usually accurate enough ($\pm 5^{o}$); however, for better accuracy then an alternative is to lightly hold the windvane pointing in the direction of North and rotate the assembly until North is displayed on the real-time display of the logger or display unit. This will obviously depend upon the unit used.

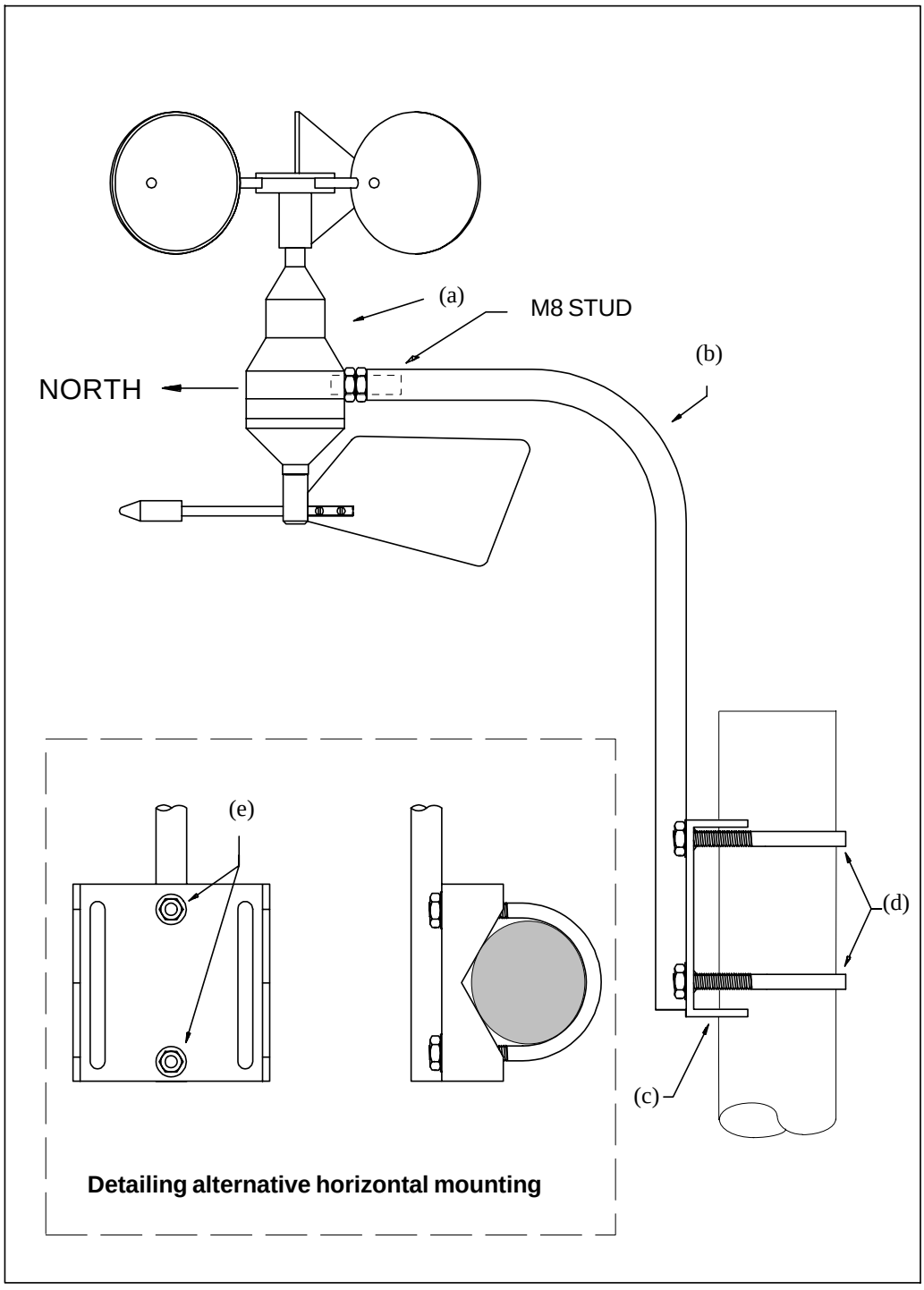

FIGURE 5 THE ASSEMBLED WSDB KIT

The easiest method of all relies on the logger firstly using a vectoring method of averaging and secondly being able to accept an offset of the resulting answer to be programmed in.

After aligning, tighten the clamps to stop the assembly from rotating. The cable ties should be fitted to ensure a tidy cable run down the mast.

If the WSDB kit is being fitted to a horizontal mast then the two M6 screws should be removed, the bracket rotated 90^{o} and the screws replaced and fully tightened. When fitting to the mast ensure that the assembly is also vertically aligned