

Wind Speed & Direction Sensor User Manual



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1. General Information

About this Manual

This manual is intended as a general guide for installing, wiring and using a Kalyx-RG rain gauge. The information contained in this manual may not cover all aspects of Kalyx-RG applications. Please refer to associated equipment manuals or consult papers and technical notes on the EML website (www.emltd.net).

Version Information

Table 1 - Document Revisions

EML Document Number:	Description:
UM-975-001	Version 1.0 – First Release, dated 19 th August 2015
	Version 2.0 – Second Release, dated 1 st March 2018
	Version 2.1 – Third Release, dated 13 th March 2019

Related Manuals

Table 2 - Related Manuals

EML Document Number:	Description:

2. Introduction

The WSD1 sensor measures both wind speed and wind direction. At the top of the unit is a 3-cupped anemometer (white) for measuring wind speed, and at the bottom, a wind vane (black) for measuring wind direction. Always ensure that this orientation is maintained. These devices are attached to the main body of the unit which is made of a clear anodised (HT30) aluminium alloy.

The wind speed (anemometer) component consists of a low-inertia ABS white cup assembly for fast response, mounted on a dual ballrace-supported stainless steel shaft. The use of a Bremag 10 magnet operates a long-life switch to produce one bounce-free pulse per revolution of the rotor.

The direction (black wind vane) component consists of a dynamically balanced vane operating a triple ballrace supported shaft and micro-torque 355° potentiometer, with a deadband of 5° at North. Most modern loggers can be connected to these sensors with little or no interfacing. An additional benefit is the very low power requirement (application of a voltage reference to the wind vane potentiometer is all that is needed).

Various possibilities exist for mounting the WS1 sensor head, a length of 8mm stainless steel studding is supplied for this purpose. However, two systems are recommended; the full mast kit WSS1 or the bracket kit WSS2. See the relevant sections within this manual for further details on the assembly and use of the above.

3. Site and Installation Requirements

Choosing a site

The site chosen to install the WSD1 sensor depends on the application and the circumstances at the site. There are a number of good-practice that should be followed, described as follows.

A site should be chosen which is as representative as possible of the wider area. Over-exposed or sheltered sites should be avoided unless it is the intention to measure in such areas. For example, on top of hills are exposed sites, whereas positioning the unit on the leeward side of obstacles will shelter it from the wind.

If deployment on a building is necessary, mounting at a central point of the building is more representative than at the edge. Two metres or ten metres above the ground are the most common mounting heights adopted.

4. Wiring & connection information

This section gives information on connecting the WSD1 to loggers, including a circuit diagram.

Wiring colours.

The cable supplied with the WSD1 sensor consists of three twisted pairs of inner conductors plus a screen. The screen is not connected within the sensor. The fitted twisted-pair cable consists of one colour plus its associated black. This means that there are three blacks within the cable. To help in this regard each conductor has been labelled with a heat shrink marker. The labels used are shown in Table 3, and the wiring diagram of the WSD1 is shown in Figure 1.

Table 3 - Wiring details

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)

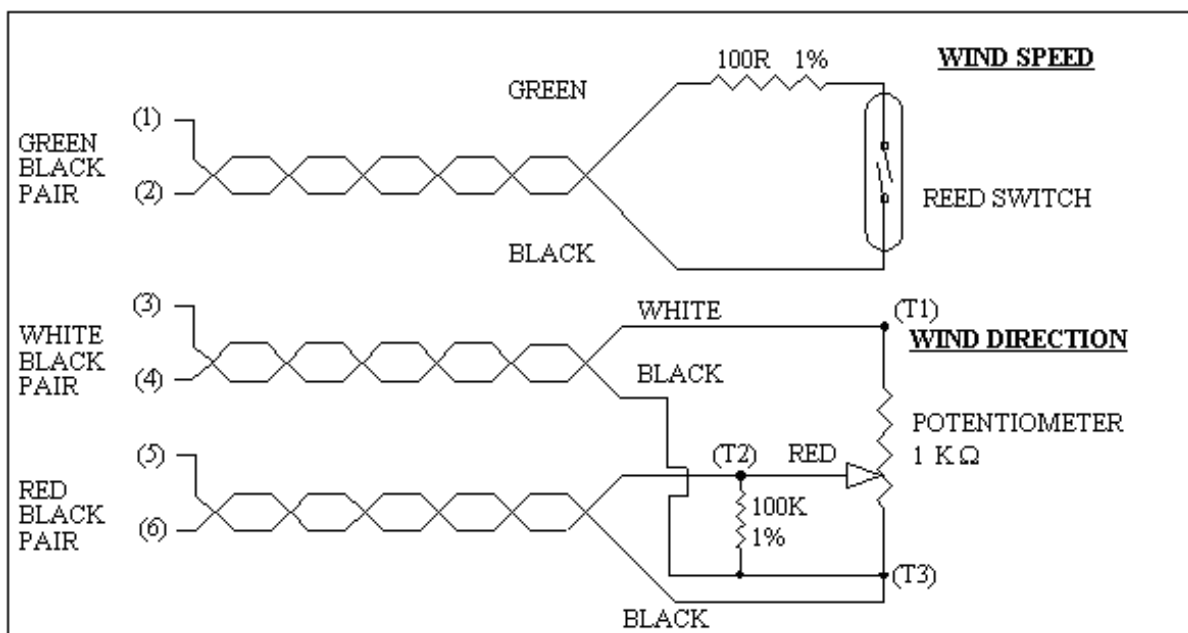


Figure 1 - Wiring diagram of WSD1

5. Additional Technical information

This section provides technical specifications for the WSD1 and the cable.

Technical Specifications of the WSD1

Speed Sensor	
Calibration	1 contact closure / 1.493m
Reed detector	Bench tested to a minimum speed of 90m/s.
Start-up ¹	0.5 m/s typically.
Accuracy	2%
Linearity	2%
Contact Rating	50 Watts. (d.c. resistive)
Direction Sensor	
Mechanical travel	360° (Endless)
Electrical travel	355° ±2°
Calibration	0 - 1K Ω potentiometer for 0-355° electrical travel.
Resistance tolerance	±3%
Linearity tolerance	±0.5%
Temperature range	-20°C to +70°C
Reference Voltage ²	1 to 24Vdc (Max: 80Vdc)
Height	280mm
Max arc (for wind vane)	120mm
Weight	500 grams approx.

Speed component of the sensor (anemometer)

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.

In the circuit diagram shown in Figure 1 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 to shortening of switch life and generation of transients in the other wires. Although only needed in longer cable runs, this resistor is fitted as standard within the sensor.

Direction component of the sensor (vane)

This is a low-torque 1k ohm potentiometer design using a 3mm shaft and associated bearings (3 off).

In the circuit diagram shown in Figure 1 a 100k ohm pull down resistor is fitted into the wiring in the sensor. This is fitted to 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 $\pm 0.5\%$ linearity.

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 used. The cable is a Belden 9503 or equivalent. The conductors are 7/0.2mm (24awg) stranded tinned copper, twisted pairs (3 pairs).

Long cable runs on the sensor

There are no problems when long cable runs are used. However, with the direction element of the sensor 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 loggers do) then use a delay to eliminate this; 10 mS is usually enough for most situations, but this does depend on the logger used.

Wind direction averaging

If a simple averaging system is used on wind-direction a problem arises around the North direction.

Example: If 355° equals a 2V full scale reading and 0° equals a 0V output.

If the wind is hovering either side of North, and a number of readings are obtained, some would be around 2V and some around 0V. If these were averaged, a result of around 1V would be obtained, equivalent to South.

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

6. Assembly and use of the WSS1.

The WSS1 consists of a WSD1 sensor plus a full mast kit for mounting the head at the standard two metres height. It is of a lightweight aluminium construction and suitable for temporary or permanent use. All alloy parts are black-anodised with the exception of the elbow, which is clear-anodised. Stainless steel screws are used throughout.

Basic assembly

Unpack and identify all parts of the WSS1 kit from the box by using Table 4, Figure 2, Figure 3 and Figure 4.

The assembly instructions will refer to the item letters contained in Table 4.

Table 4 - Contents list of WSS1 kit.

Item	No. off	Description
a	1	WSD1 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

Lower mast assembly

The mast is supplied part-assembled and requires swinging the lower tube (d1) of the mast through 90° 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).

Upper mast assembly

The upper mast also comes part-assembled with 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 pre-assembled 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.

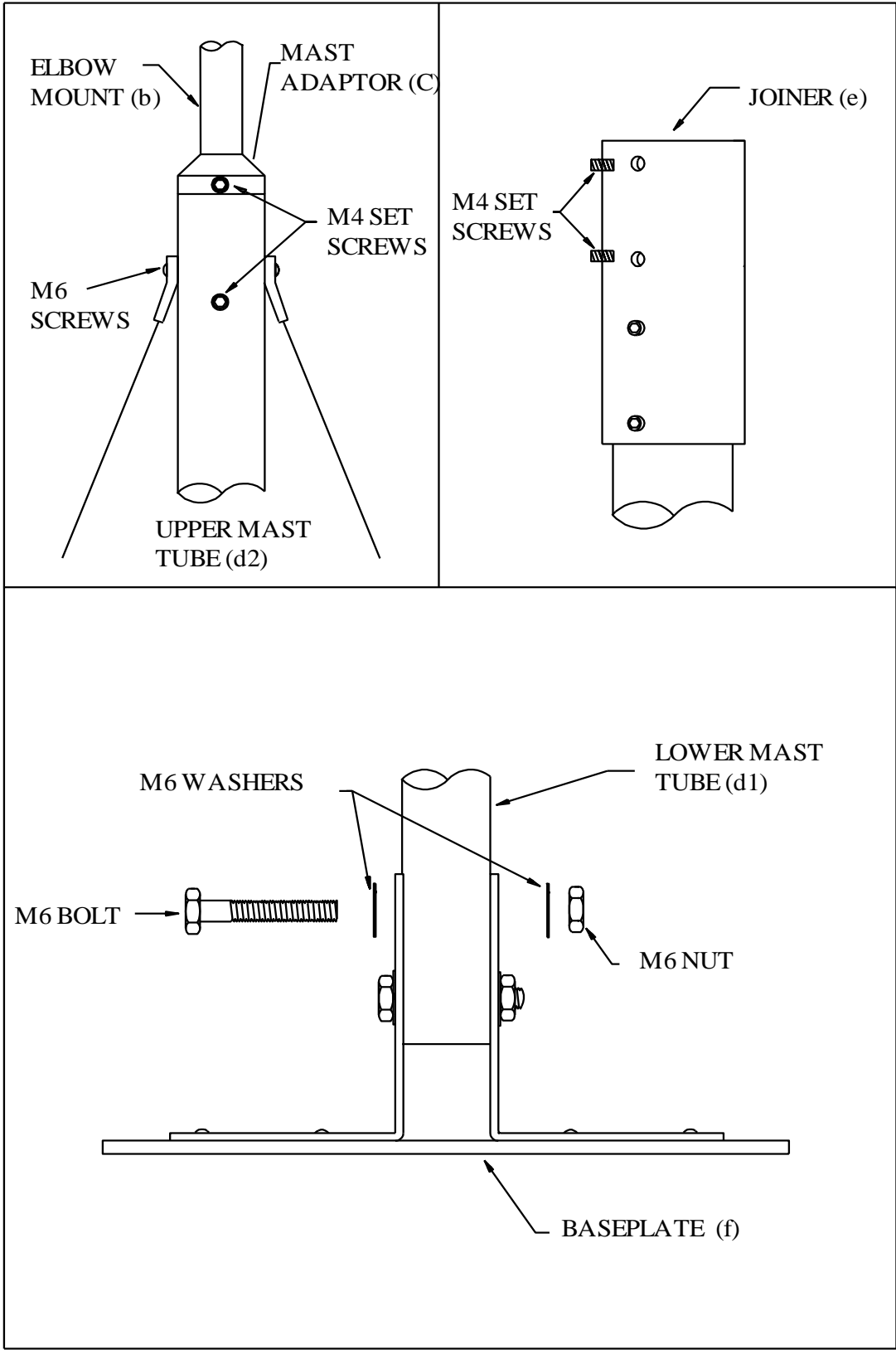


Figure 2 - Mast assembly detail

Final assembly

If the system is being assembled in the field then the four steel pegs should be fitted through the corners of the Baseplate (f) and into the ground. They may require knocking in 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 equally spaced around the mast, while at the same time ensuring the distance from the mast is compatible with the length of the guy ropes.

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 locknuts.

Screw the M8 stud of the WSD1 (a) into the threaded end of the elbow (b) and then place end of elbow (b) into the top of the mast.

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 to $\pm 5^\circ$.

After aligning, tighten the six M4 set-screws to stop the elbow(b) from rotating. Cable ties should be fitted to ensure a tidy cable run down the mast. 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, therefore cable ties are essential.

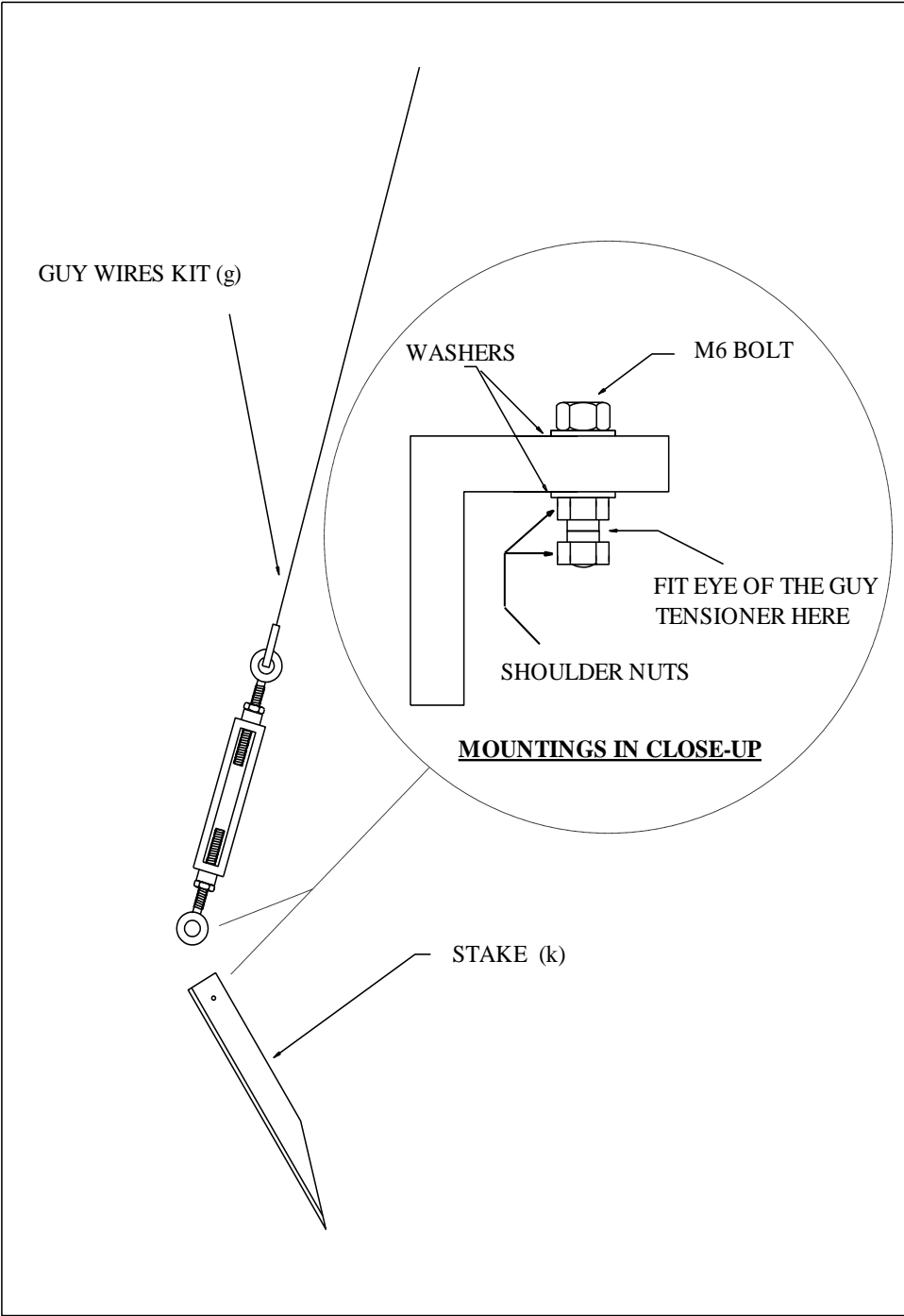


Figure 3 - Guy wiring detail

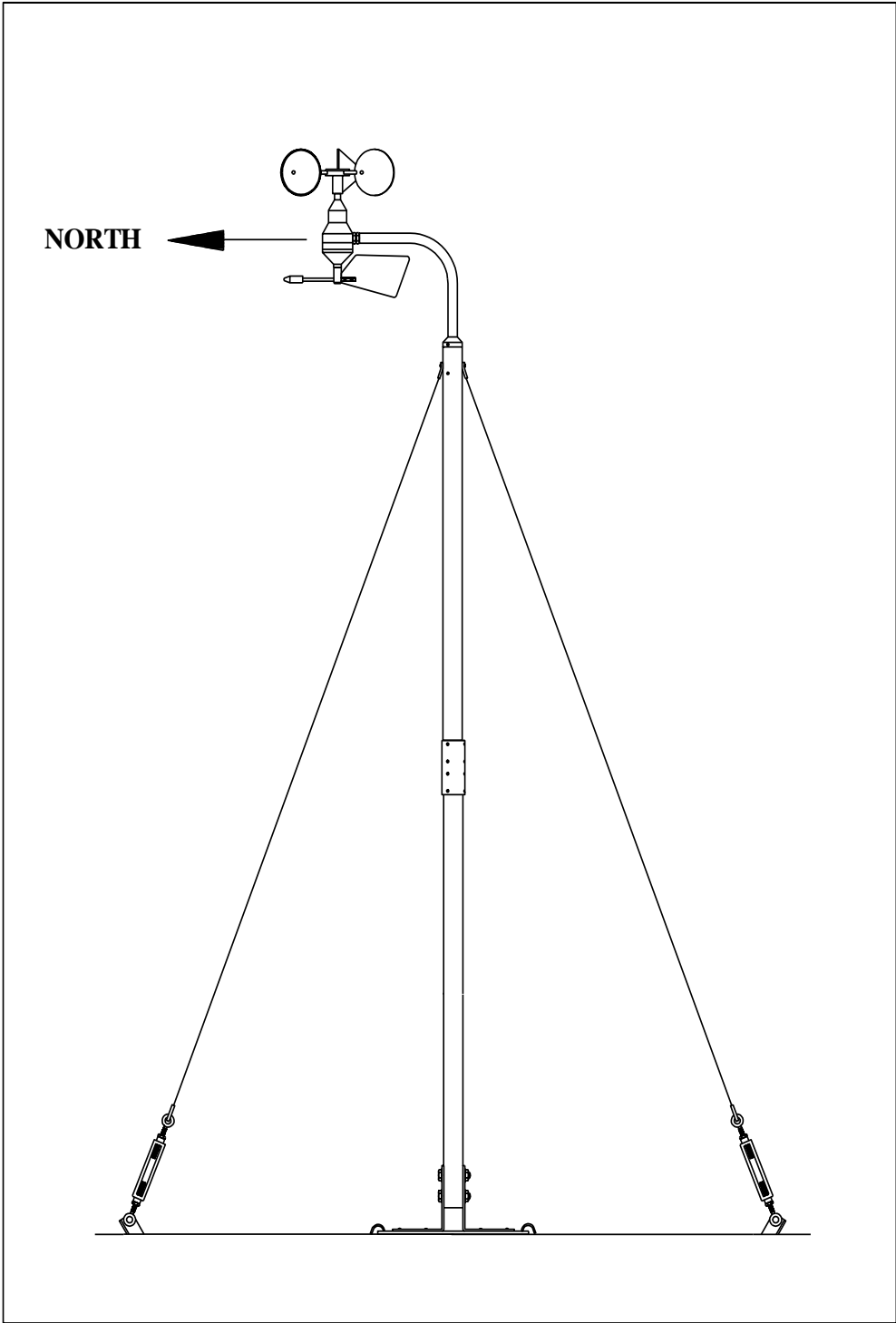


Figure 4 - Assembled WSS1

7. Assembly and use of the WSS2.

The WSS2 product consists of the WSD1 sensor plus a simpler mounting than the WSS1 kit, used when fixing to masts or poles of up to 2" (50mm) in diameter. The mount is a clear-anodised alloy.

Unpacking and Assembly

Unpack and identify all parts of the WSS2 kit from the box by using Table 5 and Figure 5.

Table 5 - Contents list of WSS2

Item	No. off	Description
a	1	WSD1 head
b	1	Elbow mount
c	1	Bracket plate
d	2	M6 U-Bolts
e	4	M6 Nuts & M6 Washers

Assembly consists of fitting the two washers (e) to the M6 bolts (d), 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 WSD1 (a) into the threaded end of the elbow mount (b), and while keeping the WSD1 (a) perpendicular to the elbow mount (b) tighten the locknut to fix the WSD1 (a) 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.

Fitting to a mast

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

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 ($\pm 5^\circ$).

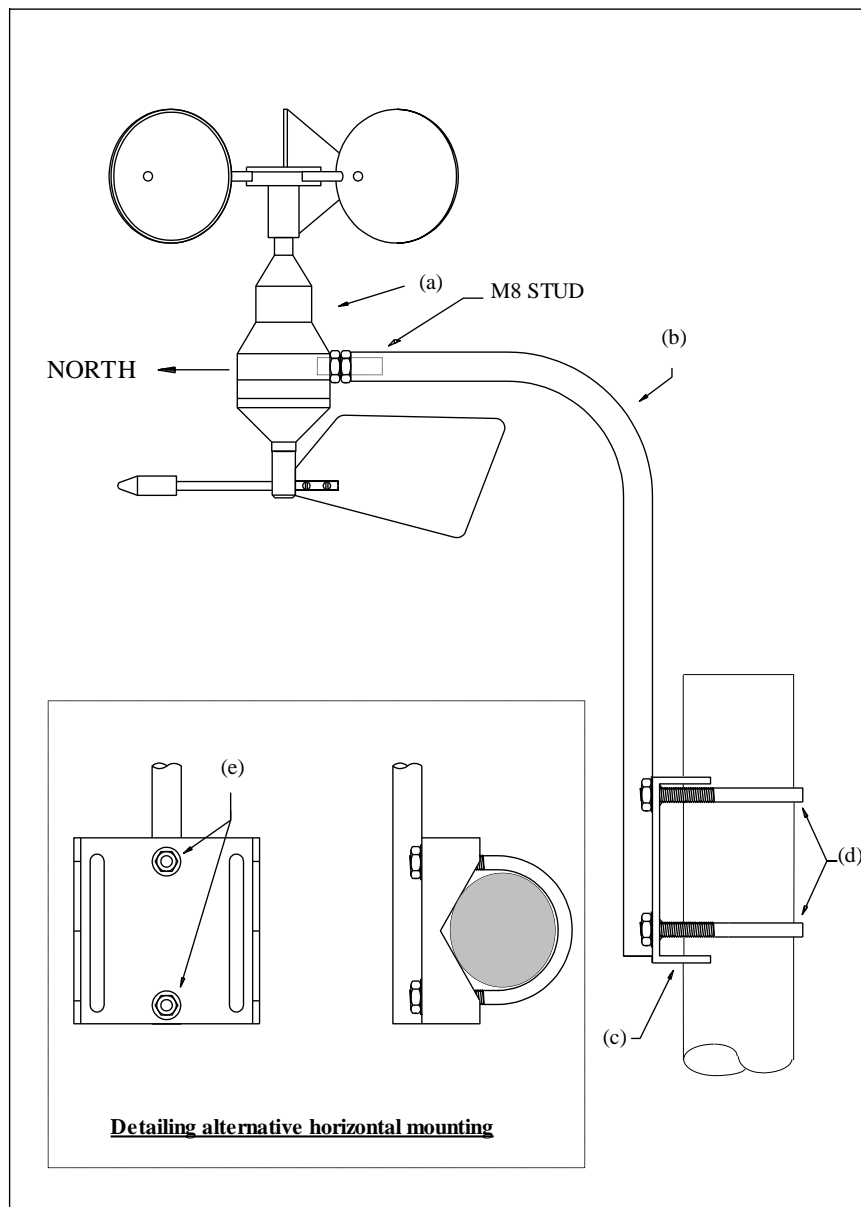


Figure 5 - Assembled WSS2 kit

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

If the WSS2 kit is being fitted to a horizontal mast then the two M6 screws (e) should be removed, the bracket rotated 90° and the screws replaced and fully tightened. When fitting to the mast ensure that the assembly is also vertically aligned.

Appendix A – Wind sensor products and spares

Table 6 – Wind sensors products

Product code	Description
W-975-001	WSD1 Wind Speed & Direction Unit
W-975-002	WSS1 Wind Speed & Direction Unit + Mast
W-975-003	WSS2 Wind Speed & Direction Unit + Bracket
W-975-010	WSU1 Wind Speed Unit
W-975-011	WSU3 Wind Speed Unit + Mast
W-975-012	WSU4 Wind Speed Unit + Bracket

Table 7 – Wind sensor spare parts

Product code	Description
W-975-020	WS/S Bearing Kit
W-975-021	WS/SD Bearing Kit
W-975-022	WS/SD Bearing Kit (+ Potentiometer)
W-975-112	Collar (after anodising)
W-975-151	Windspeed body assembly
W-975-153	Rotor Assembly
W-975-158	Windspeed Cup assembly
W-975-159	Wind Vane assembly
W-975-160	Elbow Assembly
W-975-315	Bearings
W-975-323	Gasket set
W-975-330	1K ohm potentiometer