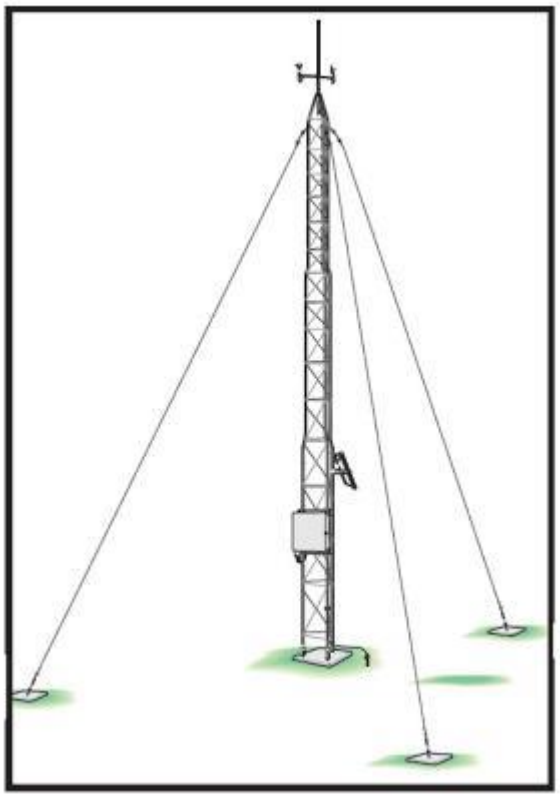
INSTRUCTION MANUAL

CAMPBELL SCIENTIFIC
WHEN MEASUREMENTS MATTER

Automatic Weather Station with UT20 or UT30 Tower



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CSL 164

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This equipment is guaranteed against defects in materials and workmanship. We will repair or replace products which prove to be defective during the guarantee period as detailed on your invoice, provided they are returned to us prepaid. The guarantee will not apply to:

- Equipment which has been modified or altered in any way without the written permission of Campbell Scientific
- Batteries
- Any product which has been subjected to misuse, neglect, acts of God or damage in transit.

Campbell Scientific will return guaranteed equipment by surface carrier prepaid. Campbell Scientific will not reimburse the claimant for costs incurred in removing and/or reinstalling equipment. This guarantee and the Company's obligation thereunder is in lieu of all other guarantees, expressed or implied, including those of suitability and fitness for a particular purpose. Campbell Scientific is not liable for consequential damage.

Please inform us before returning equipment and obtain a Repair Reference Number whether the repair is under guarantee or not. Please state the faults as clearly as possible, and if the product is out of the guarantee period it should be accompanied by a purchase order. Quotations for repairs can be given on request. It is the policy of Campbell Scientific to protect the health of its employees and provide a safe working environment, in support of this policy a "Declaration of Hazardous Material and Decontamination" form will be issued for completion.

When returning equipment, the Repair Reference Number must be clearly marked on the outside of the package. Complete the "Declaration of Hazardous Material and Decontamination" form and ensure a completed copy is returned with your goods. Please note your Repair may not be processed if you do not include a copy of this form and Campbell Scientific Ltd reserves the right to return goods at the customers' expense.

Note that goods sent air freight are subject to Customs clearance fees which Campbell Scientific will charge to customers. In many cases, these charges are greater than the cost of the repair.

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PLEASE READ FIRST

About this manual

Some useful conversion factors:

Area: 1 in^2 (square inch) = 645 mm^2

Length: 1 in. (inch) = 25.4 mm
1 ft (foot) = 304.8 mm
1 yard = 0.914 m
1 mile = 1.609 km

Mass: 1 oz. (ounce) = 28.35 g
1 lb (pound weight) = 0.454 kg

Pressure: 1 psi (lb/in^2) = 68.95 mb

Volume: 1 UK pint = 568.3 ml
1 UK gallon = 4.546 litres
1 US gallon = 3.785 litres

Recycling information

At the end of this product's life it should not be put in commercial or domestic refuse but sent for recycling. Any batteries contained within the product or used during the products life should be removed from the product and also be sent to an appropriate recycling facility.

Campbell Scientific Ltd can advise on the recycling of the equipment and in some cases arrange collection and the correct disposal of it, although charges may apply for some items or territories.

For further advice or support, please contact Campbell Scientific Ltd, or your local agent.

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Precautions

DANGER — MANY HAZARDS ARE ASSOCIATED WITH INSTALLING, USING, MAINTAINING, AND WORKING ON OR AROUND **TRIPODS, TOWERS, AND ANY ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC**. FAILURE TO PROPERLY AND COMPLETELY ASSEMBLE, INSTALL, OPERATE, USE, AND MAINTAIN TRIPODS, TOWERS, AND ATTACHMENTS, AND FAILURE TO HEED WARNINGS, INCREASES THE RISK OF DEATH, ACCIDENT, SERIOUS INJURY, PROPERTY DAMAGE, AND PRODUCT FAILURE. TAKE ALL REASONABLE PRECAUTIONS TO AVOID THESE HAZARDS. CHECK WITH YOUR ORGANIZATION'S SAFETY COORDINATOR (OR POLICY) FOR PROCEDURES AND REQUIRED PROTECTIVE EQUIPMENT PRIOR TO PERFORMING ANY WORK.

Use tripods, towers, and attachments to tripods and towers only for purposes for which they are designed. Do not exceed design limits. Be familiar and comply with all instructions provided in product manuals. Manuals are available at www.campbellsci.eu or by telephoning +44(0) 1509 828 888 (UK). You are responsible for conformance with governing codes and regulations, including safety regulations, and the integrity and location of structures or land to which towers, tripods, and any attachments are attached. Installation sites should be evaluated and approved by a qualified engineer. If questions or concerns arise regarding installation, use, or maintenance of tripods, towers, attachments, or electrical connections, consult with a licensed and qualified engineer or electrician.

General

- Prior to performing site or installation work, obtain required approvals and permits. Comply with all governing structure-height regulations, such as those of the FAA in the USA.
- Use only qualified personnel for installation, use, and maintenance of tripods and towers, and any attachments to tripods and towers. The use of licensed and qualified contractors is highly recommended.
- Read all applicable instructions carefully and understand procedures thoroughly before beginning work.
- Wear a **hardhat** and **eye protection**, and take **other appropriate safety precautions** while working on or around tripods and towers.
- **Do not climb** tripods or towers at any time, and prohibit climbing by other persons. Take reasonable precautions to secure tripod and tower sites from trespassers.
- Use only manufacturer recommended parts, materials, and tools.

Utility and Electrical

- **You can be killed** or sustain serious bodily injury if the tripod, tower, or attachments you are installing, constructing, using, or maintaining, or a tool, stake, or anchor, come in **contact with overhead or underground utility lines**.
- Maintain a distance of at least one-and-one-half times structure height, or 20 feet, or the distance required by applicable law, **whichever is greater**, between overhead utility lines and the structure (tripod, tower, attachments, or tools).
- Prior to performing site or installation work, inform all utility companies and have all underground utilities marked.
- Comply with all electrical codes. Electrical equipment and related grounding devices should be installed by a licensed and qualified electrician.

Elevated Work and Weather

- Exercise extreme caution when performing elevated work.
- Use appropriate equipment and safety practices.
- During installation and maintenance, keep tower and tripod sites clear of un-trained or non-essential personnel. Take precautions to prevent elevated tools and objects from dropping.
- Do not perform any work in inclement weather, including wind, rain, snow, lightning, etc.

Maintenance

- Periodically (at least yearly) check for wear and damage, including corrosion, stress cracks, frayed cables, loose cable clamps, cable tightness, etc. and take necessary corrective actions.
- Periodically (at least yearly) check electrical ground connections.

WHILE EVERY ATTEMPT IS MADE TO EMBODY THE HIGHEST DEGREE OF SAFETY IN ALL CAMPBELL SCIENTIFIC PRODUCTS, THE CUSTOMER ASSUMES ALL RISK FROM ANY INJURY RESULTING FROM IMPROPER INSTALLATION, USE, OR MAINTENANCE OF TRIPODS, TOWERS, OR ATTACHMENTS TO TRIPODS AND TOWERS SUCH AS SENSORS, CROSSARMS, ENCLOSURES, ANTENNAS, ETC.

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Automatic Weather Station with UT20 or UT30 Instrumentation Tower – Safety Instructions

Before you proceed with any installation work in connection with your UT20/UT30-based station, you must read and take note of the safety recommendations given below. DO NOT CLIMB the tower. All high-level sensors etc. must be installed with the tower at ground level.

S.1 Local Safety Regulations

The UT20/UT30 are purpose-designed lattice-type towers, made from welded aluminium.

Before you install the base and erect the tower you must ensure that the complete installation complies with any local safety regulations covering such structures.

S.2 Selecting a Site for the Weather Station

NOTE A minimum of two people are required to safely assemble and erect the tower and to test the sensors and other weather station components.

The choice of location for your tower-based weather station will depend on a number of circumstances, and these are thoroughly discussed in Section I.1 of this manual. After selecting a suitable site you must thoroughly check the general area for potential hazards which may occur during erection:

- Ensure that ground conditions are suitable for the concrete bases which secure the tower anchor bolts and base assembly. (See Section 1 of this manual).
- Check the ground level and slope to ensure that the guy wires, if used, can be properly fixed to give a stable installation.
- Ensure that no utility services are located where you will need to dig foundations. Check with the appropriate authorities if unsure.
- Check for any obstructions, bearing in mind that the tower will need to be raised into its final position.

WARNING **Check particularly for overhead obstructions such as power cables and other wiring. If any part of the weather station structure comes into contact with power lines you could be killed.**

S.3 Before Assembly

Before assembling the tower ensure that all parts of the tower, appropriate sensors, tools and safety equipment are readily available. A full equipment list is given in the Introduction Section of this manual.

WARNING **Never use damaged or incorrect components. If in doubt about the suitability of any component or equipment please seek expert advice.**

S.4 Do Not Climb The Tower

Although the design of the tower produces a well made and strong structure, *do not attempt* to climb the tower for any purpose.

It is possible to install and service the sensors and raise and lower the tower using the base assembly as a hinge. A detailed explanation of how to fit the sensors and other components while the tower is on the ground is given in Section 2 of this manual.

WARNING **DO NOT CLIMB the tower, whether guyed or unguyed, for any reason. Carry out the fitting and maintenance of all high-level sensors with the tower on the ground as detailed later in this manual.**

S.5 Maintenance

S.5.1 Structure

It is important to carry out maintenance at regular intervals as detailed in Section 2 of this manual in order to preserve the overall integrity of the structure. Take special care to inspect for any rust or corrosion on the bolts, guy wires (where fitted), clips and ground anchors, especially at ground level, where pockets of moisture may exist.

S.5.2 Electrical

Check all wiring and electrical connections regularly for signs of wear or damage, including all earth connections.

WARNING **Where mains power is involved it is essential that you check for effective earthing of components before any maintenance work or testing is carried out.**

Automatic Weather Station with UT20/UT30 Instrumentation Tower – Introduction

Thank you for buying your weather station equipment from Campbell Scientific. This manual includes information about siting, assembly and maintenance of a typical Automatic Weather Station, based on the UT20 (7 metre) and UT30 (10 metre) aluminium Antenna/Instrumentation Towers. Please read this Installation Manual carefully before attempting to erect the tower and/or using your AWS, as it contains important information about siting, assembly, and maintenance. ***You MUST read the SAFETY INSTRUCTIONS at the front of this manual.***

This manual also includes introductory information about programming. Using this information, together with any other instruction manuals provided for specific components, you should be able to start making measurements fairly quickly. Please remember, however, that an AWS is sophisticated scientific equipment, and as such it may take some time for you to become completely familiar with its use.

We recommend that you begin by reading through the entire manual to become familiar with its content, identifying the component parts of your AWS as you do so. When you are ready for assembly, go back a second time, and follow the instructions given.

I.1 Choosing the Location for Your AWS

The siting of an Automatic Weather Station is crucial. This section briefly describes several factors which can affect the results obtained. Please read through this information before deciding where to locate your AWS.

NOTE The descriptions in this introductory section are general rules for all types of weather stations and are not specific or exhaustive for any one type; for further information, please refer to meteorological publications.

The objective of any data collection exercise is to obtain data that is accurate, reliable and representative. Accuracy and reliability depend mostly on the correct selection and use of sensors. Data representativeness refers to the extent to which the values recorded are typical of the site or location in which the sensors are placed.

Automatic weather stations are often used to provide local meteorological measurements that otherwise could only be obtained from a ‘standard’ meteorological site, perhaps some inconvenient distance away. In this case the AWS should be exposed in a similar way to the instruments on the standard site, i.e. over a short grass surface that is level and not shielded by trees or buildings. The standard site is designed to allow representative measurements of local weather and not of a specific microclimate. It is important that the instruments are positioned at a similar height to those on other meteorological sites; in the UK, measurements of air temperature and humidity are normally made with a Stevenson Screen at 1.2 m above the ground. A standard height for anemometers on such a site is 10 m, but 2-3 m is considered acceptable for semi-permanent installations.

In other cases, an AWS is required to measure the true conditions at a site — possibly to determine how much these differ from the standard conditions measured over a regional network of meteorological stations. Here, the AWS should be exposed over a relatively uniform area of terrain. Some care is required in interpreting the measurements obtained, however, because gradients of air temperature, humidity and wind speed increase as the distance from the surface decreases.

As an example, consider an AWS sited in a crop of newly planted corn with the anemometer 2 m above the ground. The measured wind speed will decrease markedly as the crop grows because the distance between the instrument and the surface is continually reducing. At harvest the anemometer may be only 20 or 30 cm above the upper foliage and the measured wind speed will be slow. This is a true representation of conditions at the height of the anemometer; it is effectively a microclimatic measurement that is not representative of the general conditions in the region.

I.2 The Effects of Varying Environmental Conditions

This section describes three ways in which local conditions such as moisture or the presence of vegetation can affect the measurements taken by an AWS. These effects are well documented and further details can be found in the meteorological literature.

I.2.1 The Clothesline Effect

The ‘clothesline effect’ in its simplest form describes the effect of air passing from dry, unvegetated surfaces to moist, vegetated surfaces and the consequent effect on vapour gradients and heat transfer. This should be carefully considered when siting an AWS in crops or near trees when the wind direction is mostly towards the vegetation.

I.2.2 The Leading Edge Effect

This effect occurs when air moves over a surface that differs in temperature, moisture content, roughness or some other characteristic from an adjacent surface. The line of discontinuity is known as the leading edge. As air passes over the leading edge its characteristics gradually adjust to the new surface. This internal boundary layer varies in vertical extent with distance from the leading edge. A transitional zone exists where the air is modified but not adjusted to the new surface. These effects become most pronounced when advection (horizontal air flow) is strongest. There are no universally accepted figures for the height of this internal boundary layer as it is influenced by the nature of the surface and the extent of any advection.

I.2.3 The Oasis Effect

The ‘oasis effect’ occurs when an isolated moisture source is surrounded by an otherwise arid region. If the wind direction is such that moist air is drawn from the surface of the water body (or other water source such as a glacier or area of vegetation), then the relative humidity measurements do not represent the general conditions in the region.

I.3 Obstructions

Whenever possible, the AWS should be located away from windbreaks or shelterbelts. Several zones have been identified upwind and downwind of a windbreak in which the airflow is unrepresentative of the general speed and direction. Eddies are generated in the lee of the windbreak and air is displaced upwind of it. The height and depth of these affected zones varies with the height and to some extent the density of the obstacle.

Generally, a structure disturbs the airflow in an upwind direction for a distance of about twice the height of the structure, and in a downwind direction for a distance of about six times the height. The airflow is also affected to a vertical distance of about twice the height of the structure. Ideally, therefore, the AWS should be located outside this zone of influence in order to obtain representative values for the region (see Figure 1).

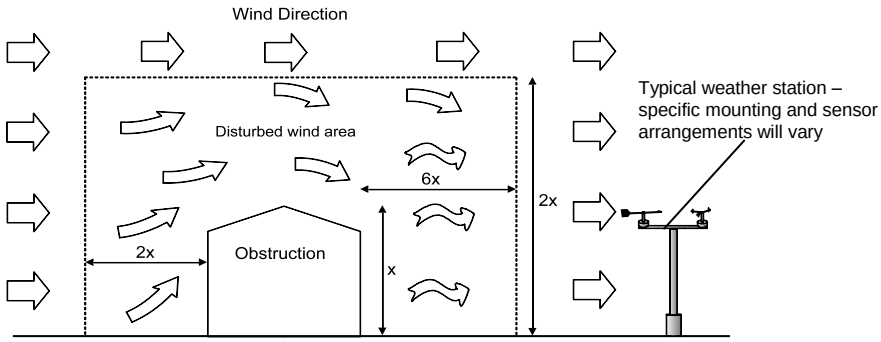

Figure I-1 Effect of Structure on Air Flow

I.4 The Effects of an Urban Environment

- If your weather station has a net radiometer be particularly cautious when siting it in a built-up area as building temperature, sky view factors and other variables affect the short-wave and long-wave components of the calculation of net radiation.

- The impervious nature of an urban surface compared to surrounding rural areas, together with the efficient channelling of water as surface run-off, leads to a generally drier environment. However, the ponding of water that occurs, for example, on flat roofs, can also lead to local areas of high relative humidity.

- Wind speeds are generally lower in urban areas compared to more exposed rural locations. However, aspects of city design and building geometry can combine to create areas of high or low wind speeds because of the funnelling of air.

I.5 Checking and Preparation

A *typical* UT20/30-based automatic weather station consists of:

- Instrumentation Tower complete with lightning spike, ground spike, earthing wire and all necessary accessories. See Section 3 for full installation details. Optional guy ropes can be provided if required.
- 011E cross arm sensor mount and T-junction connector for anemometer and windvane

- A100R wind speed sensor (anemometer)
- W200P wind direction sensor
- 016E pyranometer support arm
- SP1110 pyranometer with SKE211 levelling fixture
- HMP45C air temperature and relative humidity sensor with URS1 Unaspirated Radiation Shield
- ARG100 tipping bucket raingauge
- Fibreglass enclosure with integral power supply (for the datalogger)
- CR10X or CR1000 datalogger.

NOTE This equipment list represents a typical configuration. Your weather station may have different or additional sensors, or you may have a lead-acid power supply with a solar panel. If you have any difficulty assembling or using your weather station after reading this Installation Manual please contact Campbell Scientific for help.

The minimum equipment you will need for satisfactory installation is as follows:

- A spirit level
- A tape measure
- A hard hat
- Industrial quality gloves and footwear
- Rustproofing compound for threads
- An adjustable spanner
- A range of standard and Phillips screwdrivers
- A compass (for wind direction orientation)
- Cable ties (supplied)
- A set of Allen hex keys (at least a 3/16")
- Suitable lengths of appropriate cable for:
    a) The connection of the AC adaptors (AC-ADAPT and AC-ADAPT2) to the PS100E charger and power supply unit
    b) The interconnection of short haul modems
    c) The extension of telephone cables to the datalogger enclosure.

If you do not have a remote communications link to the weather station, you will also need the following items to test a system:

Either

- A CR10KD or CR1000 Keyboard/Display (connected to the datalogger with an SC12 cable)

or

- A laptop PC with PC200W, PC400 or LoggerNet software installed (connected to the datalogger with either an SC32A interface + SC25AT cable + SC12 cable or an SC929 interface cable).

Additional items may be needed depending on the nature of the installation. These are given in the appropriate section, but may include:

- A mallet (for driving in ground spike)
- Silicone rubber sealant
- A protractor (for adjusting solar panel angle)

- Step ladders (for installing sensors and levelling pyranometer)
- Pipe Wrench
- Shovel, pickaxe and trowel for making the concrete base foundations.
- Materials to make the foundations (wood formers, concrete mixture etc.)
- Wire rope cutter (if using guy ropes on your installation)
- A length of rope to assist in raising the tower.

There should be a minimum of two people on site for the safe installation and setting up of a complete tower-based weather station.

Section 1. Site Preparation and Assembly of the Tower

Before starting any work on your UT20 or UT30-based weather station, please read the SAFETY INSTRUCTIONS at the front of this manual.

This section describes the site preparation for, and preliminary assembly of, the Instrumentation Tower.

See Section 2 for the assembly of sensors and other components and the final erection of the tower. Section 2 also details the procedure for guying the tower where this is required and where the optional guying kit is provided.

1.1 Introduction

The UT20 and UT30 are tubular aluminium towers with two (UT20) or three (UT30) main sections plus a mast assembly, giving an overall height of approximately 7 m and 10 m respectively. The sections are triangular in cross-section and consist of three aluminium tubes braced by continuous aluminium rod welded in a multiple 'Z' pattern. This gives a very low overall weight and the tower can easily be erected. Optional guy rope assemblies can be supplied where required.

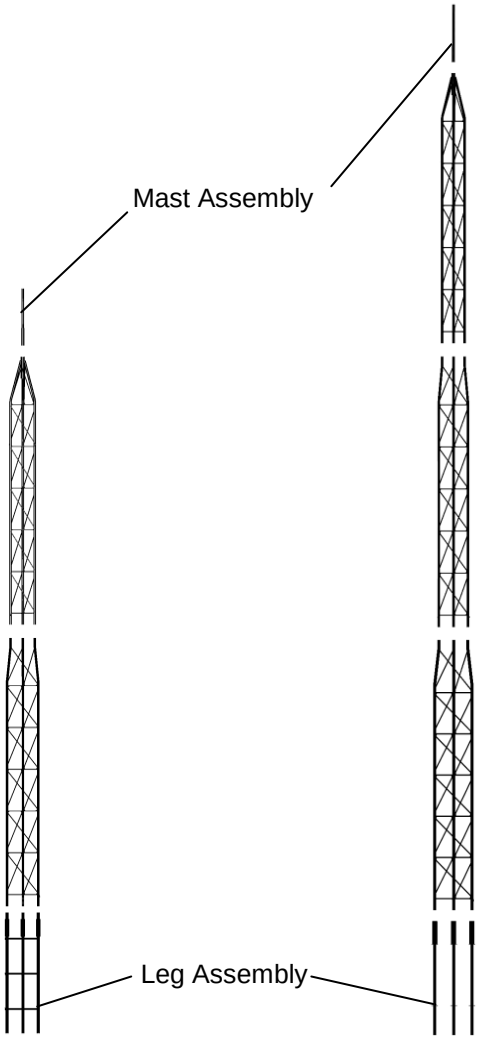

Figure 1-1 UT20 and UT30 Towers, showing Tower Sections

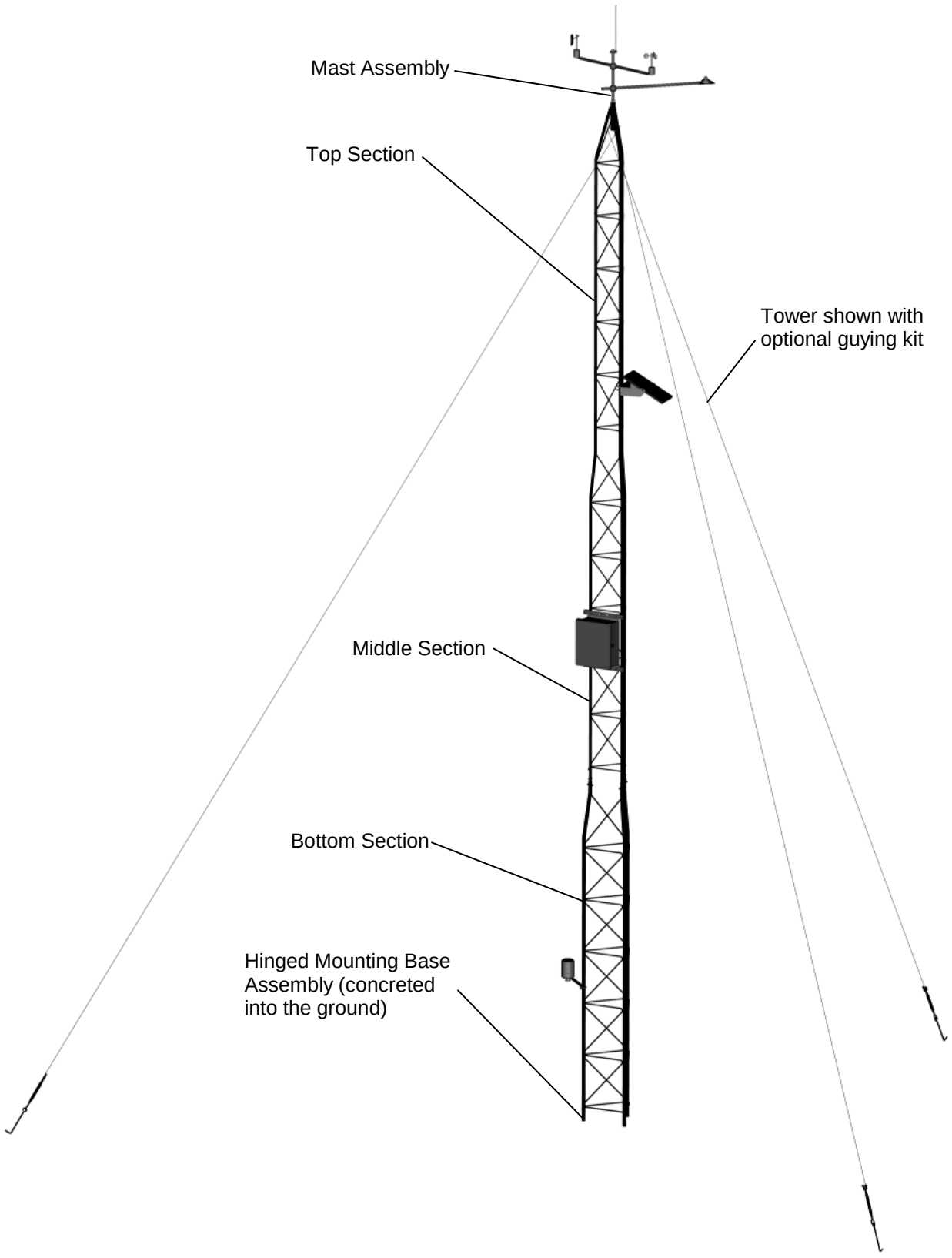

Figure 1-2 UT30 Tower Assembly, with Enclosure, Solar Panel and a Typical Range of Sensors

1.2 Description

The tower sections are made from 32 mm (1¼") OD aluminium tube. The mast is made from the same material but is reduced to 25 mm (1") OD for the top 450 mm to accommodate the 405-1, 016E, 017E or 018E crossarm. Two bolts are used to secure the mast to the collar in the top section of the tower.

The towers are designed for use with special base assemblies, which are embedded in concrete (see Figure 1-3). Roof-mount base assemblies, for mounting onto suitably constructed roof areas or other flat surfaces (see Figure 1-4), are available to special order. Please contact Campbell Scientific for further advice.

1.2.1 Guying

Standard towers are not supplied with guy ropes. If your particular site is subject to consistently high wind speeds or turbulence, a guy rope assembly kit can be supplied to minimise vibration effects on the tower and instrumentation.

Section 2 of this manual gives full instructions for guying the tower where required.

WARNING **Do not attempt to climb the structure (whether guyed or not) either to do initial installation or to carry out routine maintenance of components. All installation and maintenance must be done with the tower at ground level as detailed in Section 2 of this manual.**

1.3 Tower Specifications

Tower Model:	**UT20**	**UT30**
Total Height (approx.) including mast	7 m	10 m
Weight (approx.): Tower Sections and Mast Standard Base Roof Mounting Base	20 kg 9 kg 9 kg	27 kg 11.3 kg 11.3 kg
Shipping Weight (approx.)	29 kg	39 kg
Tower Shipping Dimensions (without guying kit) Base assembly	360x360x3048 mm 360x360x1320 mm (packed separately)	457x457x3048 mm (legs packed with tower assembly)
Max. wind gust survival for a bare unguyed tower with standard base	45 ms^{-1} (100 mph)	45 ms^{-1} (100 mph)

1.3.1 Accessories

The following accessories are available from Campbell Scientific:

Model Number	**Description**
URS1	12-plate radiation shield
405-1	Vector cross-arm
016E	Pyranometer mounting arm
017E	Wind Monitor mounting arm
018E	Combined Wind Monitor/pyranometer mounting arm
009546	Guy Rope assembly

1.4 Site Preparation

You are recommended to take a full tool set of metric and imperial spanners on site. Minimum requirements are given in the following sections.

CAUTION Always take sensible precautions during installation of any metalwork. We recommend that you use industrial quality gloves and protective footwear to minimise the possibility of minor injuries.

1.5 Base Installation

Choose the location of your tower base carefully, remembering that you will need sufficient space to assemble the tower on the ground before attaching it to the hinged base and 'walking' it into its upright position.

The base sections for the UT20 and UT30 differ slightly in design – the UT30 uses three separate legs, whereas the UT20 base is an integrated assembly. The following instructions generally illustrate the UT30 base, but the UT20 base is fitted in a similar way.

If you will be using the optional guy rope assembly, you will also need to consider the positions of the guy anchors – please refer to Section 1.6, below.

CAUTION NEVER place any *aluminium* tower section directly into a concrete base. The corrosive effects of the concrete on aluminium will damage the tower and void the warranty. Use only the steel base/leg assemblies as shown below. You must also ensure good water drainage for the aluminium tubing on all the tower sections to minimise the possibility of trapped water freezing (and possibly causing splits in the tubing). The supplied bases allow for adequate drainage; you must ensure that the bottom openings of the aluminium tubes do not become blocked.

(The *steel* legs can, however, be suitably treated to prevent water ingress and to minimise rusting.)

1.5.1 Base Installation

For a base installation you will need:

- A shovel
- A pickaxe
- A spirit level
- A 4 metre tape measure
- A hammer
- A concrete trowel
- Two 9/16" open-ended spanners

Locate where the tower base is to be installed and place the tower sections end to end in the correct order of assembly. Make sure enough clearance exists so that the tower can later be 'walked' up to its upright position without overhead interference.

Dig a hole 900 mm square by 1200 mm deep. Install the bottom section of the tower to the base using two bolts per leg, making sure that all three legs are fitted to allow for tilt in the same direction – see Figure 1-3.

Set the base, with the bottom tower section attached, into the hole. Orient the tower for the proper tilt direction, and make sure that the upper round flanges on the legs will be at approximately 12 mm above the *finished* height of the concrete (see Figure 1-3).

It is very important to ensure that the bottom tower section is vertical. As concrete is poured into the hole, periodically check that the tower is vertical using a spirit level and make adjustments as necessary. Allow three to four days for the concrete to cure.

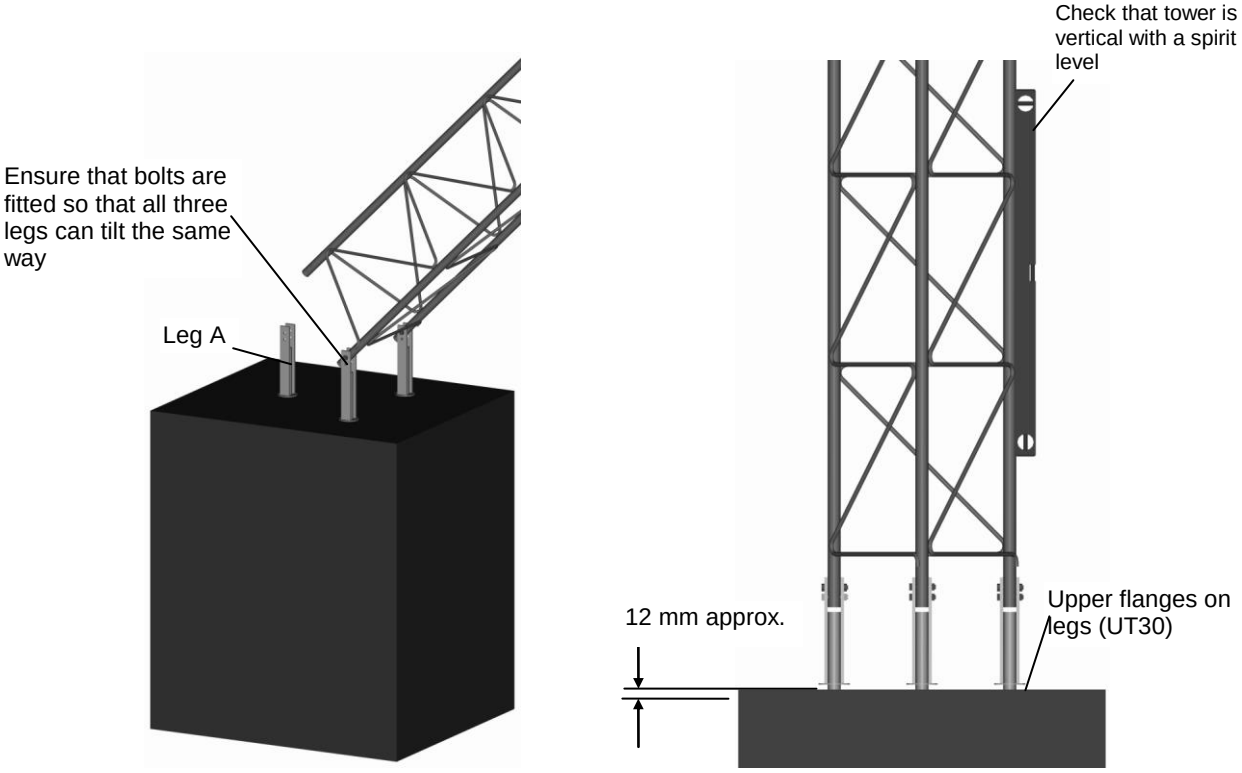

Figure 1-3 Bottom Tower Section and Base Installation

1.5.2 Special Roof-Mounting Base Installation

The roof-mounting base has been designed for mounting to flat surfaces such as flat concrete slabs or flat roofs. For installation you will need:

- Three suitable bolts or other mounting anchors
- A 9/16" open-end spanner
- A spirit level
- A guying kit and fixing points to the roof

CAUTION

You must take careful consideration of site conditions and roof construction (if roof mounted) before installing the roof-mount base. If you are at all unsure about the construction or structural integrity of the roof, you must seek expert advice before attempting to mount the base. We recommend roof mounted masts must be guyed.

Locate where the tower base is to be installed and place the tower sections end to end in the correct order of assembly. Make sure that enough clearance exists so that the tower can later be 'walked' up to its upright position without overhead interference.

WARNING

As with a ground mounted installation, you *must* check particularly for overhead obstructions such as power cables and other wiring around the building. If any part of the weather station structure comes into contact with power lines you could be badly injured or killed.

Attach the bottom section of the tower to the base using one bolt per leg. Stand the base and tower section upright, and orient for the proper tilt direction (see Figure 1-4). Install the base to the roof using three lag bolts, or other anchors appropriate for the application (see Caution above). Before tightening the bolts, check that the tower is vertical and add shims or other packing material to the base if necessary.

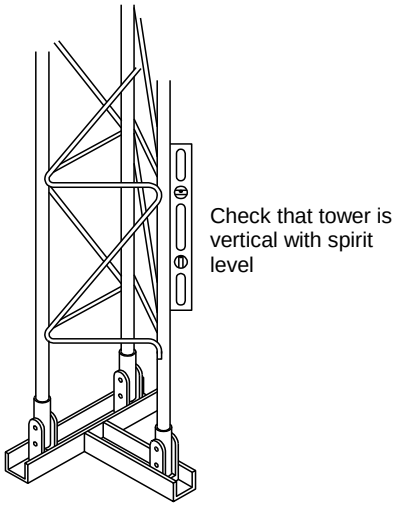

Figure 1-4 Special Roof-Mounting Base Installation for UT30

1.5.3 Lightning Protection for Roof Mounted Towers

You will be supplied with a standard lightning/grounding kit as detailed in Section 2.9 of this manual. Both the main and secondary grounding wires are intended to reach to a grounding spike adjacent to the tower. For a roof mounted tower it is your responsibility to make suitable arrangements for the grounding wires to be properly grounded. This may be by connecting them to existing lightning protection equipment on the building, or, alternatively, by running a new grounding wire down the building to the ground spike or other suitable grounding point. If you are unsure about the provision of adequate lightning protection, you should seek expert advice.

1.6 Ground Anchor Layout (for Optional Guying Kit)

If you are using the optional guying kit, you will need to consider the overall site layout both for the tower position and the siting of the guy anchors as detailed below.

To lay out the base installation with optional guy anchors you will need:

- A 15 metre tape measure
- Four stakes
- 6 metres of non-stretch line

Figure 1-5 shows the layout of the guy anchors in relationship to the tower base. To mark the positions of the guy anchors:

1. Drive a stake into the ground where the tower is to be located.
2. Attach a line to the stake and scribe a circle with a 3.6 metre radius (for UT20) or a 5.2 metre radius (for UT30).
3. Choose a tilt direction for the tower.
4. From the centre point, walk in the opposite direction and drive a stake into the ground on the scribed line (see Figure 1-5). This marks the position of the rear leg anchor.
5. Locate the other anchor points by measuring 6.2 metres (UT20) or 9 metres (UT30) from the rear tower leg anchor stake to the scribed line.

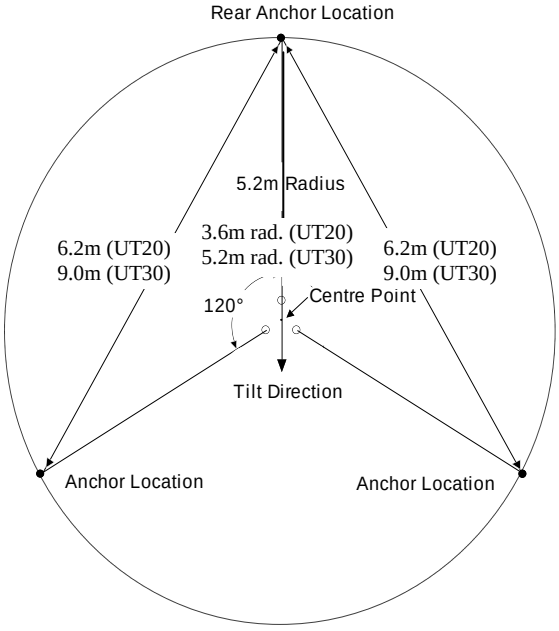

Figure 1-5 Top View of Base and Optional Ground Anchor Layout

1.6.1 Ground Anchor Installation

To install the ground anchors you will need:

- A shovel
- A pickaxe
- A 3 metre tape measure
- A concrete trowel

Locate the three anchor points (see Figure 1-5) and dig three holes 600 mm square by 600 mm deep. Fill the holes with concrete and install the eyebolts as shown in Figure 1-6.

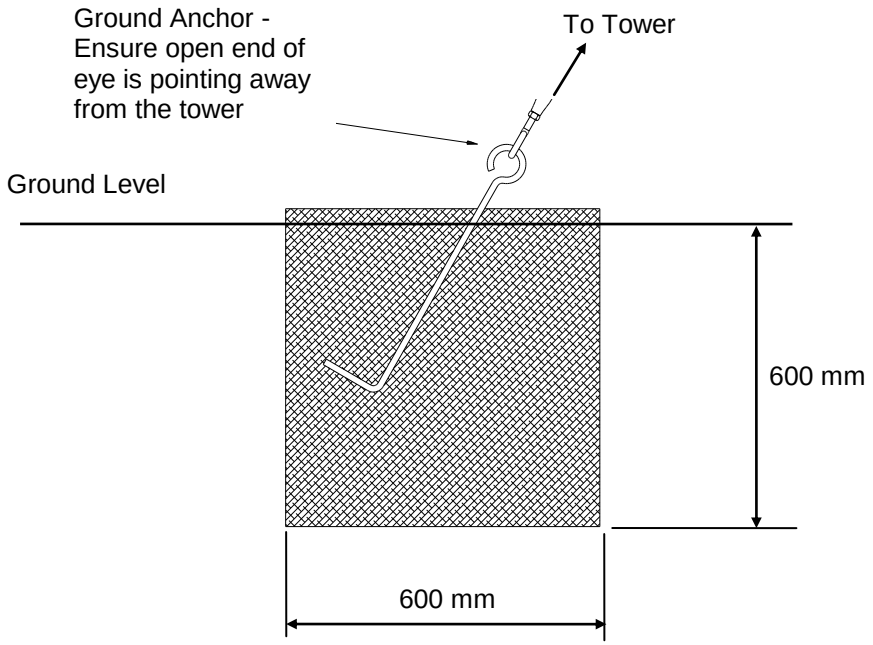

Figure 1-6 Ground Anchor Installation

1.7 Tower Assembly

To install the tower and guy ropes (if fitted) you will need:

- Two 9/16" open end spanners
- A 9/16" socket and ratchet
- A tape measure
- A 1/8" Allen Key
- A flat blade screwdriver
- UV-resistant wire ties
- A pair of cutters
- A 7 mm nut driver
- A pair of wire rope cutters
- A spirit level
- A pair of pliers

Having previously installed the base and bottom tower section, remove both bolts from the rear tower leg. Remove the lower bolts and loosen the upper bolts in the other two legs so that the bottom tower section is free to hinge – see Figure 1-3. Tilt the bottom tower section to the ground and assemble the middle section. Note that only *one* bolt is required per leg for this (there may also be a blind hole in each leg which should *not* be drilled out). See Figure 1-7, below. Do not attach the top mast section to the main mast yet, as you may need to attach mounting arms and sensors to this section as detailed in Section 2.

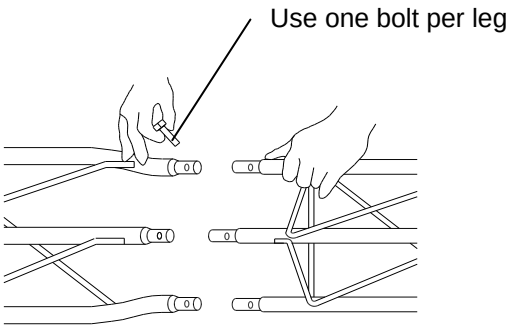

Figure 1-7 Fitting the Tower Sections

1.8 Fitting AWS Components and Erecting the Tower

Section 2 of this manual details the fitting of sensors and other equipment, and the final erection and guying of the tower.

Section 2. Assembly of Components and Erection of Tower

This section gives details of how to fit, level and align typical sensors and ancillary equipment and how to erect the tower and fit the optional guy wires.

Before fitting components or erecting the tower, please read the SAFETY INSTRUCTIONS at the front of this manual.

Some sensors (especially those that will be mounted at the top of the tower, such as windvanes, etc.) must be fitted and levelled/aligned while the tower is at ground level, before it is raised. This section discusses the correct way to achieve this, as well as giving assembly instructions for other sensors plus the solar panel and the enclosure, which can be fitted after the tower is raised.

2.1 Assess Site and Sensor Requirements

Each site will have its own individual requirements, but, before attaching any sensors and equipment to the tower, you should give some consideration on where to mount them. Some sensors, such as windvanes, will need to be mounted at the top of the tower. Other sensors and equipment, such as radiation monitors, solar panels and enclosures can be mounted at various levels. You should assess the requirements for your particular site, weighing the need for periodic maintenance/ease of access against possible anti-vandalism measures, etc. For instance, a radiation monitor or pyranometer could be mounted at a high level (to deter vandalism and give better exposure to light), but this would make periodic maintenance, such as cleaning, more difficult and you may wish to mount such instruments at a lower level, accessible directly from the ground or by using a step-ladder.

NOTES

1. This manual does not cover sensors which will not be mounted on the tower itself (e.g. tipping bucket raingauge) or which are not part of a standard weather station (e.g. snow depth gauge). For installation details of these sensors, please refer to the manuals provided with them, or contact Campbell Scientific for assistance.
2. Different types of mounting arm are described in this section. Most weather stations will not require all of these arms. Where more than one arm is fitted (e.g. an 011E and an 016E), ensure that the wind sensors are mounted on the higher arm so that any other arms do not affect wind measurements.
3. You may wish, where possible, to pre-assemble certain components in a workshop or other sheltered place before final assembly in the field. This could save time and frustration when assembling and fitting in less favourable circumstances. Such tasks include, for example, securing the Relative Humidity sensor inside its radiation shield and attaching other sensors loosely to their mounting arms ready for final adjustment.

Once the tower base has been installed, all the sensors and other components which will be mounted beyond easy reach should be assembled, attached to the tower and aligned while the tower is still on the ground (as described in this section) before the tower is raised.

2.2 Fitting the Mast Assembly and Lightning Rod

Attach the mast assembly to the top tower section by sliding it into the hole in the central boss until the weld on the assembly is just above the top of the boss. Tighten the setscrews to achieve maximum security.

Fit the lightning rod assembly to the mast as shown in Figures 2-1 and 2-6 below, using the special clamp supplied.

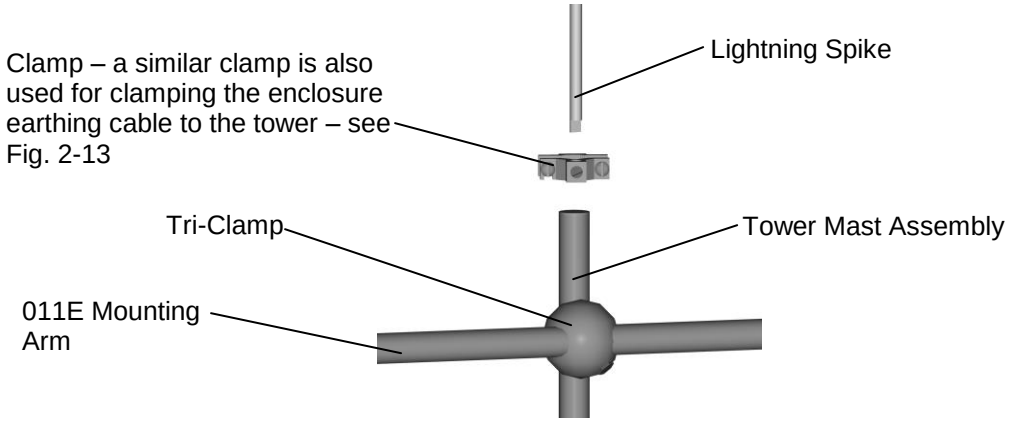

Figure 2-1 Attaching the Lightning Spike

2.3 Fitting Equipment to the Top Tower Section

Some sensors will have to be fitted to the top tower section while it is on the ground. The pyranometer is fitted and levelled *before* the tower top section is attached to the rest of the tower assembly, while windvanes will need to be attached to the top section *after* it is fitted to the rest of the tower structure, but before the tower is raised. Exact details are given below.

2.3.1 Fitting the Pyranometer to the Top Mast Assembly

It is essential that pyranometers are fitted, aligned and levelled as accurately as possible, following the advice given below, in order to reduce the likelihood of measurement errors. This section gives details of mounting the pyranometer to the top mast assembly. This is the recommended mounting position for the pyranometer as it minimises any shading effects, but you may wish to mount it elsewhere on the tower structure to facilitate maintenance – see further comments below.

To ensure correct levelling of these sensors, it is recommended that, before fitting to the main tower, you place the top tower section on a level piece of ground in an upright position and in the same relative position it will be when fitted to the tower in its 'working' position (see Figure 2-2). Use a spirit level to ensure that the section is perfectly level before fitting the sensors. You may need to pack the legs to achieve this.

You may also need a stepladder to reach the highest part of this section. If so, ensure that there is room to properly position the ladder for safe working. It is strongly recommended that there is a second person to hold and stabilise the stepladder while in use.

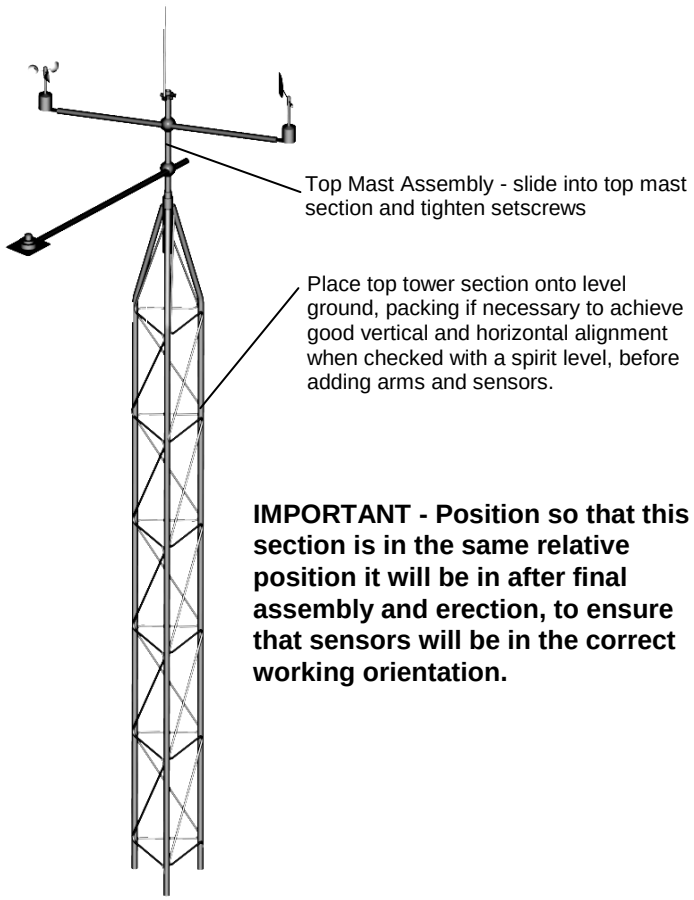

Figure 2-2 Top Tower Section at Ground Level

The standard mounting arm supplied with the pyranometer is the 016E, and the pyranometer is normally mounted on the tower top mast assembly (as shown in Figure 2-6, below) as this will effectively eliminate shading problems from the tower structure. However, cleaning and other maintenance requirements will necessitate lowering the tower to the ground, and so, for easier maintenance, you may wish to mount the pyranometer lower down the structure so that it is accessible either directly from the ground or by using a step-ladder. In this case, care should be taken that the pyranometer is mounted so that there is minimal shading from the tower structure at all times. In the Northern hemisphere, the pyranometer should be facing due South to help achieve this.

The mounting arm is supplied complete with a special ‘tri-clamp' which is suitable for both top mast fitting or fitting onto the main tower structure. The following section gives details of mounting the pyranometer on the top mast assembly. Section 2.7 describes mounting it on the tower structure at a lower level.

With the top tower section correctly levelled and oriented as shown in Figure 2-2, complete the assembly as follows:

1. Attach the pyranometer to the levelling fixture.
2. Fix the levelling fixture to the mounting arm with the two diametrically opposed bolts and secure it with the nuts below the plate. Only tighten the nuts finger-tight until the pyranometer has been levelled, as detailed below.
3. Approximately level the sensor – this may be by using three wing nuts or standard hexagon head nuts, depending on the model of the sensor.

4. Attach the mounting arm and pyranometer to the top mast assembly with the universal mounting bracket, as shown in Figure 2-6. Orient the arm to face approximately south relative to the tower to minimise the possibility of any part of the structure or other instruments casting a shadow onto the pyranometer.
5. Make final adjustments for level and orientation, and fully secure the pyranometer to the arm, and the arm to the mast.
6. Slide the whole top tower section into place on the main tower, and secure with the bolts supplied (see Figure 2-3). This will need to be done with extreme care in order to avoid altering the alignment and levelling of the pyranometer.
7. The windset should now be fitted to the top mast assembly, before the tower is raised, as outlined in the following section.

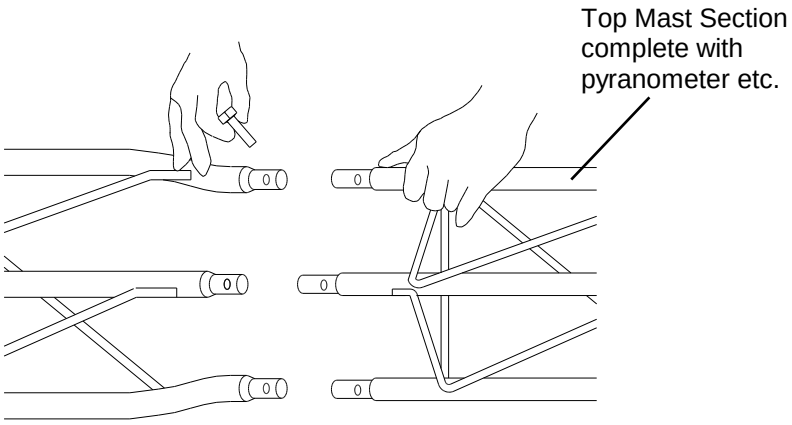

Figure 2-3 Attaching the Top Tower Section

NOTE If you are not mounting the pyranometer on the top mast assembly as described above, you should mount the arm to face approximately south relative to the tower and always bear in mind, and attempt to minimise, any possible shading effects of the structure on the pyranometer. See Section 2.6.

2.3.2 Fitting the 011E Mounting Arm and Vector Instruments Wind Speed/Direction Sensors

The 011E cross-arm sensor mount is supplied with a special tri-clamp connector and is attached to the tower top mast assembly, above the pyranometer (if fitted). See Figure 2-6, below.

As it is essential that the windset is set up and mounted as accurately as possible, it must be attached to the tower mast assembly and aligned while the tower is lying flat along the ground. The procedure outlined below must be followed exactly to ensure that your windset will provide accurate and reliable readings.

1. Assemble the windset components on their mounting arm and lightly secure.
2. Ensure that the tower structure is lying flat along the ground in an approximately horizontal position. You may need to pack the structure to achieve this.

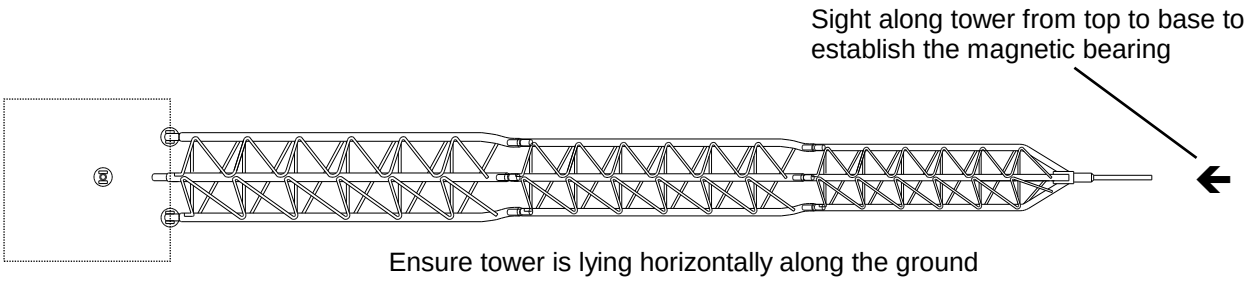

Figure 2-4 Sighting Along the Tower to Check the Magnetic Bearing

3. Sight along the tower, from the mast end towards the base as shown in Figure 2-4, above and, using a high quality compass, establish its magnetic bearing. It is recommended that you set up the wind sensor with respect to *true* north. Using an ordnance survey map (or other documentation) establish the declination angle for true north in your vicinity. Calculate true north by adding this angle to the magnetic bearing. For example, if the magnetic bearing is +37 degrees and the declination angle is +3 degrees, the adjusted bearing for true north is 37+3=40 degrees. (See Appendix A for a general discussion about true north and declination angles.) Make a note of this adjusted angle as you will need to use it to accurately set your wind direction sensor.
4. Attach the wind sensor mounting arm to the tower mast assembly and line it up in an approximately east/west direction (not in line with the pyranometer).
5. Once the wind sensors are mounted, you may need to rotate the body to ensure correct wind direction readings and/or to move the cable to a convenient position. A pair of spacers and long screws are included with the 011E arm to allow this. In addition, a nylon washer is supplied which can be used to stop the spacer and screw falling out of the mounting arm during installation.
6. Weight the fin of the wind sensor, by attaching a weight of some kind, so that it is held perpendicular to the ground. A makeshift weight might be a heavy bolt attached to the fin by two strips of adhesive insulating tape – see Figure 2-5.
7. Connect the windvane (temporarily) to the datalogger (see the datalogger and/or windvane manuals for details), and, if using a CR10/10X attach the CR10KD keyboard/display (or computer running appropriate software) to the datalogger. Use the *6 Mode on the datalogger to display the input location for wind direction measurements.
8. Whilst the windvane fin is held (by the weight) perpendicular to the ground, loosen the body of the windvane and rotate it until the display shows the angle for true north (see paragraph 3 above). After ensuring the windvane is still vertical, secure the body in this position. The windvane is now set to true north. Remove the weight.
9. Disconnect the sensor from the datalogger and secure the sensor wiring to the tower with cable ties. Ensure that there is sufficient wiring to reach the position of the datalogger enclosure when the tower is fully raised to its working position.

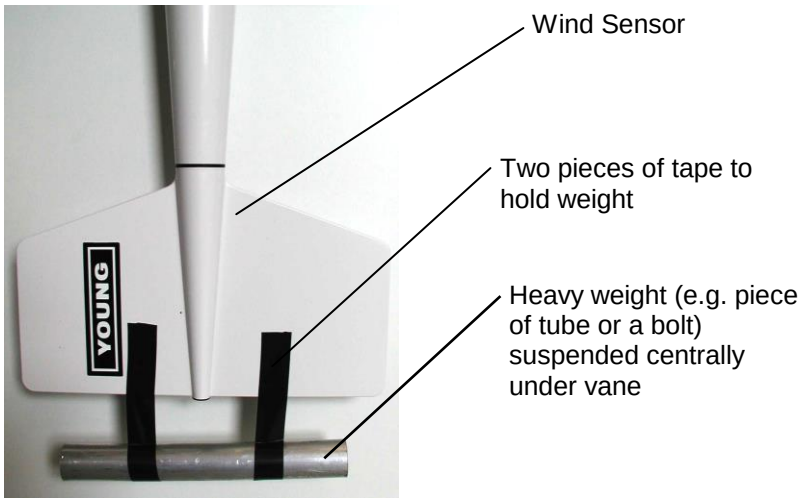

Figure 2-5 Weighting the Wind Sensor Perpendicular to the Ground

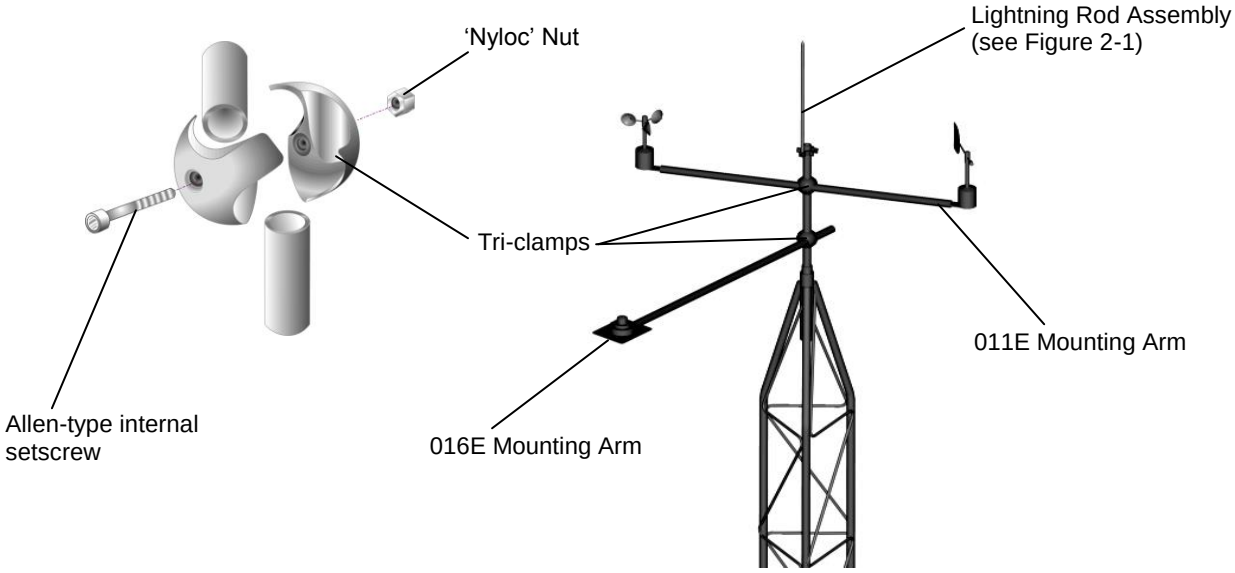

Figure 2-6 Both Mounting Arms and Sensors in Final Position on the Tower Mast Assembly

NOTE See Appendix A for a general discussion on how to set various wind sensors to true north.

CAUTION

1. Ensure that the rotor of the Vector wind speed sensor and the vane of the wind direction sensor are correctly fitted, as described above and in the sensor manuals. Failure to do so can lead to false measurements or damage to the sensors.
2. Do not attempt to remove the rotor of the wind speed sensor or the vane of the wind direction sensor while the sensors are fixed to the cross-arm. The correct procedure is described in the sensor manuals.

2.3.3 017E Arm — Wind Monitor Only

This simple sensor mounting arm is supplied with two tri-clamps and a mounting tube for the Wind Monitor. Mount the 017E as follows:

1. Ensure that the tower is lying flat along the ground as detailed above for the 011E mounting arm.
2. Position one tri-clamp at each end of the arm.
3. Position the arm, using a tri-clamp, onto the tower mast assembly and adjust the position of the arm so that the eventual height of the Wind Monitor propeller will be in the correct orientation. Fully tighten the setscrew in the tri-clamp with an Allen key.
4. Fit the Wind Monitor mounting tube (supplied with the 017E) to the Wind Monitor and tighten the stainless steel clamp to hold it in place.
5. Assemble the Wind Monitor using a tri-clamp connector at the end of the 017E.
6. Check that the Wind Monitor rotates freely and is perpendicular to the ground, and fully tighten the Allen screw in the tri-clamp.
7. Generally align the Wind Monitor to *true* North following the instructions given for the 011E arm above, and in Appendix A.

2.3.4 018E Arm — Wind Monitor and Pyranometer

This arm is a combination of the 016E and 017E and is assembled in the same way as described for those arms, starting with the pyranometer. The 018E arm should be fitted, together with the pyranometer, before the tower top section is attached to the main tower structure, as discussed in Section 2.3.1, above. Ensure that the pyranometer end of the arm points South. After fitting and levelling the pyranometer, carefully attach the top tower section to the main tower structure.

Attach the Wind Monitor to the arm with the tower fully assembled but lying on the ground. Set the Wind Monitor to true north as discussed above.

2.4 Fitting Optional Guy Wires to Tower Top Section

If you will be fitting the optional guying kit, you will need to attach the guy wires to the tower before it is raised to its working position as follows:

1. Cut the guy wire into three pieces – the lengths may differ, depending on your site layout and slope, so ensure that you know the lengths before cutting.

2. Attach the guy wires to the top tower section, taking each guy wire in turn around the structure and fitting it securely using *three* U-bolts for each wire, spaced as shown in Figure 2-7, below. Note the position of the ‘standing’ side of the guy wire.

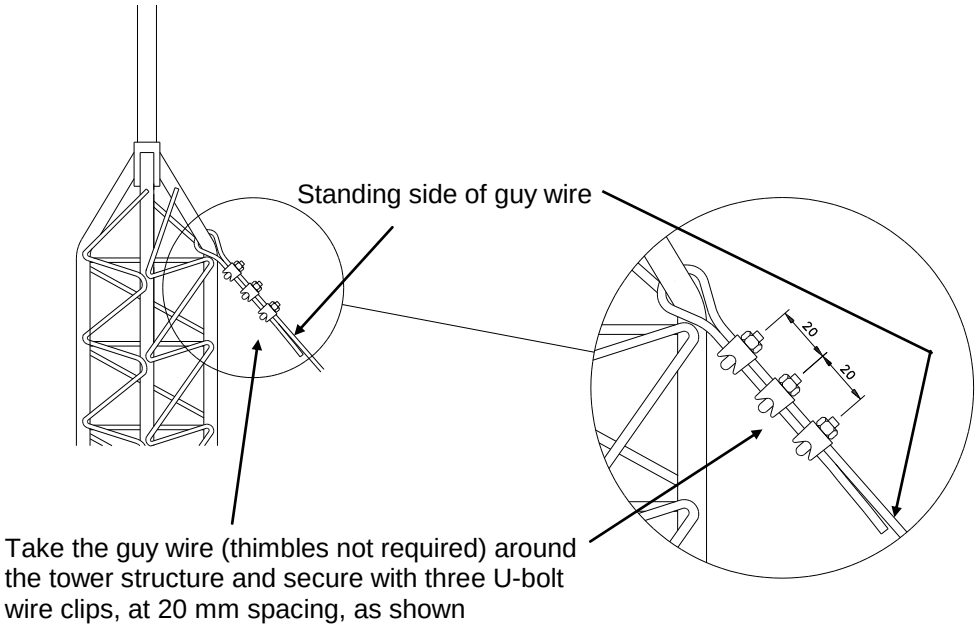

Figure 2-7 Installation of Guy Wires to Tower

NOTE All U-bolt Rope Clips must be fitted as shown in Figure 2-7, with three U-bolts at approximately 20 mm centres. The U-bolts should be on the short side of the guy wire and the nuts on the standing side.

2.5 Final Checks

After fitting, levelling and orienting the high-level sensors as discussed, the next step is to raise the tower and secure the optional guy wires, if being used.

NOTE Before raising the tower, double-check all the high-level instruments and wiring. Ensure that the instrumentation wiring is long enough to reach to the position of the enclosure. Always allow extra wiring for ease of assembly. Attach the wiring to the tower with the cable ties.

Remember, if you make an error, you will probably have to lower the tower again to correct any problems, so check all details carefully.

2.6 Tower Erection

After all the appropriate sensors have been fitted, as outlined above, the tower can be raised. Carefully 'walk' the tower (see Figure 2-8) to its upright position and fit and tighten the two remaining bolts in the base assembly. Again, ensure that the sensor wiring can reach the site of the enclosure, and that the high level sensors appear to be in their correct orientations.

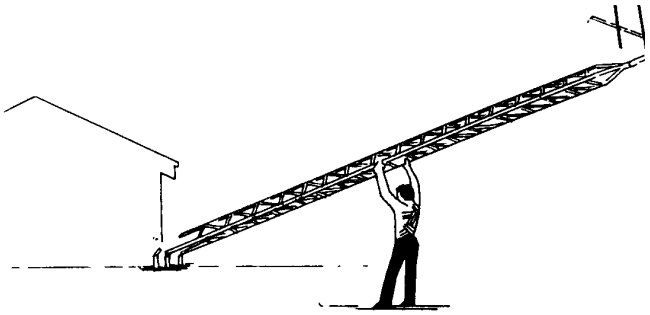

Figure 2-8 'Walking' the Tower into the Upright Position

2.6.1 Fitting Optional Guy Wires to Ground Anchors

This section includes full details of installing the optional guy wires and can be ignored for a normal, unguyed, installation.

Ensure that you have all parts of the guying kit to hand. Unscrew the jaw and eye bolts from each turnbuckle until about 25 mm of thread extends through the turnbuckle body. Attach the jaw end of the turnbuckles to the anchors, and, while holding the tower vertical, attach the guy wires to the eye end of the turnbuckles using one thimble and three U-bolts per guy wire as shown in Figure 2-7. The U-bolts should be fitted as shown, at a spacing of 20 mm, with the nuts on the 'live' side of the guy wire. Tighten the turnbuckles until it is *just* possible to pull the shackle by hand approximately 10 mm into the eye bolt, as shown in Figure 2-9.

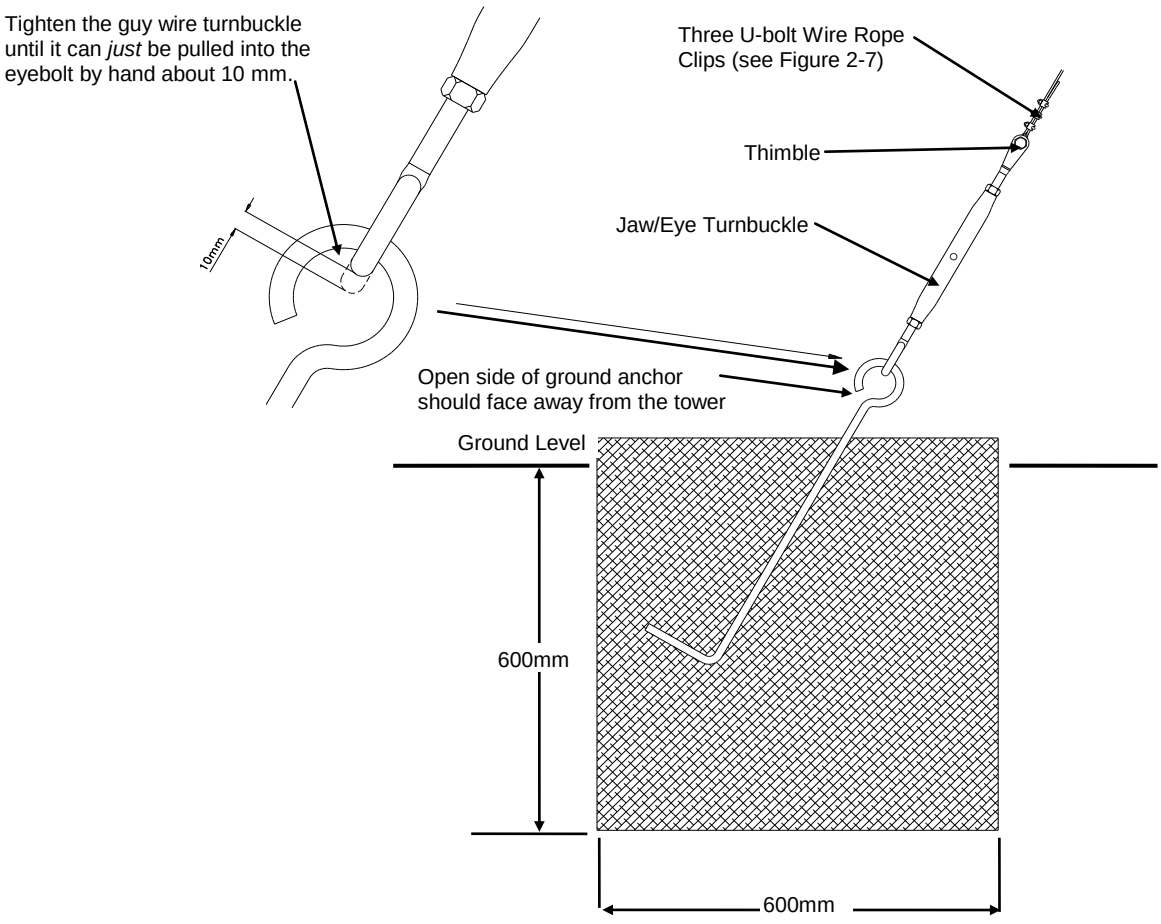

Figure 2-9 Installation of the Guy Wires to the Ground Anchors

2.7 Mounting Low Level Sensors and Other Equipment

Low level sensors can be fitted, together with the enclosure, solar panel and other equipment, after the tower is raised. If you wish to mount them high enough to deter vandals (i.e. above easy reach from the ground) you may need a stepladder.

2.7.1 Pyranometer

If you decided not to mount the pyranometer at the top of the tower, as detailed earlier, it can be mounted virtually anywhere on the main tower structure using the tri-clamp connector. It can be mounted so that it can be reached directly from ground level for ease of access, but you may prefer to mount it higher than this. If so, you will need a stepladder to access it.

Pre-assemble the pyranometer to the 016E mounting arm, as detailed in Section 2.3, before mounting the arm to the tower. Carefully select the mounting position, as the tower itself can cast shadows onto the pyranometer and so cause errors in readings. Try to ensure that no shadows will be cast at any time of the day or year. It is usual to align the arm pointing due south (in the northern hemisphere).

Attach the arm and pyranometer to the structure and check the level of the pyranometer using the built-in bubble levelling gauge. Fully secure the arm to the tower and check that the pyranometer is still perfectly level. Adjust as necessary and tighten the mounting screws.

2.7.2 Temperature/Relative Humidity Probe

The sensor can be inserted into the radiation shield before it is mounted on the tower. This is done by loosening the large hexagonal nut and inserting the sensor into the shield, twisting slightly if necessary, until approximately 40-50 mm of the sensor tube is visible at the base of the shield. Secure the sensor in position by tightening the large, plastic hexagonal nut, which in turn forces a rubber ring inwards to grip the sensor.

Secure the radiation shield to the tower with the U-bolt and wing nuts. For ‘standard’ measurements, the sensor should be attached at a height of 1.2 m, although the exact height will depend on the nature of the application.

2.7.3 Mounting the Enclosure

If your tower is part of a complete Campbell Scientific weather station, you will need to install and wire up all your components. Assembly instruction for the most commonly supplied components are given below.

You will need to assess the best position on the tower to mount your enclosure, weighing up ease of access with the need to minimise problems with vandalism etc. in the locality. If you decide to mount the enclosure above head height you will probably need to use a stepladder for access.

NOTE The instructions in this Section apply only to the ENC series enclosures. If your weather station has a different type of enclosure and you are not sure how to mount it, please call Campbell Scientific for assistance.

The ENC-MOUNT kit includes two brackets for mounting on the back of the enclosure, plus four ‘V’ bolts for mounting the bracket onto the tower.

With the tower erected and levelled, mount the enclosure as follows:

1. Mount one bracket on the top two holes of the enclosure and the other on the two bottom holes. The 8 mm bolts supplied are used to attach the brackets. Fit the brackets with the 'V' cut-outs pointing away from the back of the enclosure. See Figure 2-10, below.

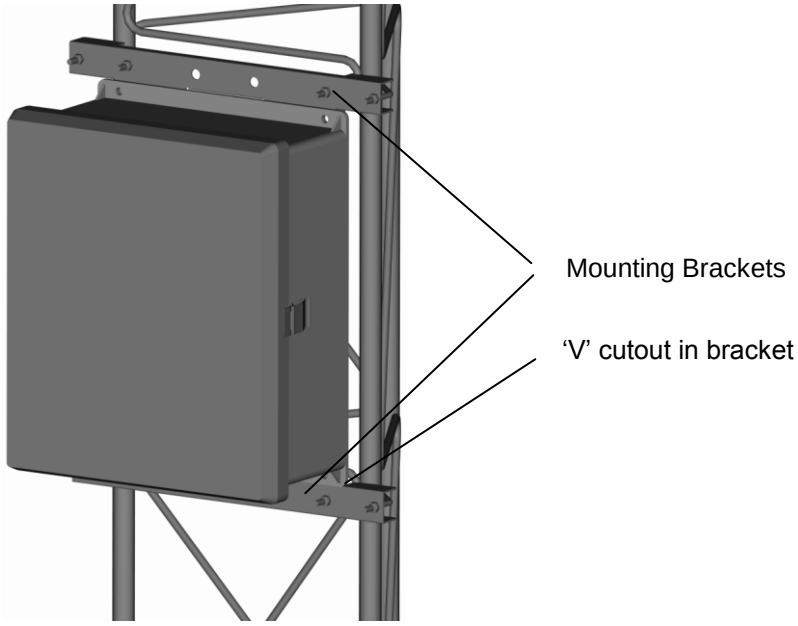

Figure 2-10 Fitting the Enclosure

2. Offer up the enclosure to the tower uprights and present the 'V' bolts from the other side of the tubing to fit into the two matching central holes of the bracket.
3. Tighten the 'V' bolts up against the tower and brackets using the 6 mm nuts.

2.7.4 Mounting a Solar Panel

If you are using a solar panel with your weather station, you will need to consider the most suitable position with regards to both operational and anti-vandalism requirements.

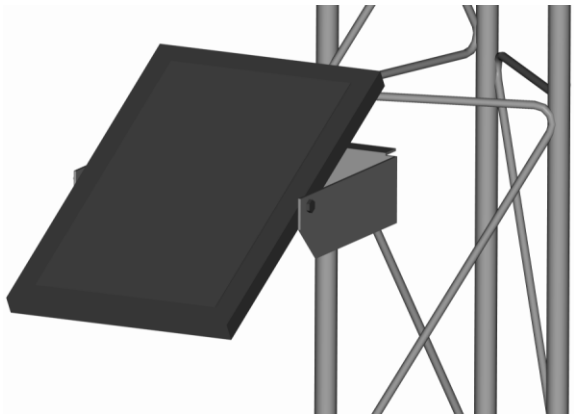

Figure 2-11 Fitting the Solar Panel

Attach the solar panel to the tower and, for northern hemisphere applications, orient it to face due south. For short-term applications the panel should be angled approximately perpendicular to the solar angle at mid-day. For longer term unattended applications such as a 12-month period, the solar panel should be angled to obtain best performance during the winter months. This 'optimum tilt angle' is equivalent to the latitude plus 15 degrees, facing permanently due south. Ensure that the solar panel will not be cast into shadow at any time by other equipment mounted on the tower.

2.8 Connections

2.8.1 Power Supply Connections

With the PS12E-LA / PS512-M Power Supplies

Route the cable from the solar panel (where fitted) into the enclosure via the cable gland or connector (if ordered). Connect it to the charger circuit of the power supply (see power supply manual).

With External Battery

Please refer to the solar panel manual for full details. Route the power cable from the external battery into the datalogger enclosure and connect it directly to the datalogger.

CAUTION When connecting an SOP18 or a solar panel supplied with a separate regulator, make sure you observe the correct polarity when connecting to the battery. Incorrect connection can destroy the regulator.

2.8.2 Final Connections

1. Secure all grounding wire and sensor cables to the tower with cable ties.
2. Fit the sensor plugs into the sockets on the base of the enclosure following the connection diagram supplied with each station.
3. Coil up any excess cable and strap it to the tower.

CAUTION It is essential to secure excess cable to the tower as unsecured lengths of cable can blow around in the wind causing the wires to break inside, sometimes without any external signs of damage.

4. Make additional connections to and from the datalogger through the large cable gland; any unused plugs or sockets should be sealed off using the sealing caps. Tighten the cable gland and check that it seals properly.

NOTE

1. Cable glands will not seal directly onto most cables, especially when more than one cable enters through a single gland. Please refer to the Maintenance section for details.
2. The small cable gland on ENC series enclosures is for venting purposes but may be used for additional cables *if venting is not needed.* Please refer to the enclosure manual for further details.

5. Apply rustproofing compound as described in the Maintenance section.

2.9 Grounding and Lightning Protection

Two different grounding kits can be supplied with the UT towers. Roof mount towers are supplied with basic clamps to allow the enclosure and tower to be bonded together. A separate clamp is provided for connection of the tower to the building earth system – the cabling and wiring of which should be done by an authorised electrician. A lightning spike is provided which should be fitted on the top of the tower.

The grounding system for ground mounted towers consists of a lightning spike, two copper-covered steel grounding spikes, grounding wire, clamps and connectors. Install the grounding system as follows:

1. Screw the black Allen screw into the straight brass connector and then screw the connector onto the blunt end of one of the copper-coated grounding spikes. Drive the spike into the ground using the Allen screw as a driving head. Position the spike as close as possible to the base of the tower.
2. Remove the Allen screw and screw the second spike into the straight connector. Drive the second spike into the ground leaving about 100 mm exposed above ground. This will drive the first spike to a depth of about 2.3 m into the ground and should provide a good ground for lightning protection purposes.

NOTE

If the ground type does not permit you to drive the spikes in to a total length of 2.3 metres then drive in the two rods individually, spaced at least 2 metres apart, and join them together using a length of the heavy gauge grounding wire, using additional clamps (available from Campbell Scientific).

3. The lightning rod should already have been installed on the top of the tower as shown in Section 2.2.
4. Connect the thicker grounding cable to the tower using the clamp provided (the same type used to clamp the lightning spike to the top of the tower mast). See Figure 2-12, below.
5. Connect the thinner grounding wire to the ground point on the underside of the enclosure and tie it to the tower to reach the ground, also as shown in Figure 2-12.
6. Connect *both* grounding cables to the exposed ground spike using the brass grounding-bond clamp provided. If you had to install the spikes separately, because of ground conditions, take the cable to the nearest spike. Try to keep the length of wires used to a minimum, without coiling the wires. See Figure 2-12.

7. Apply Waxoyl (or similar rustproofing compound) to the areas around the lightning spike clamp, the grounding cable clamp and where the grounding cable connects to the ground spike.

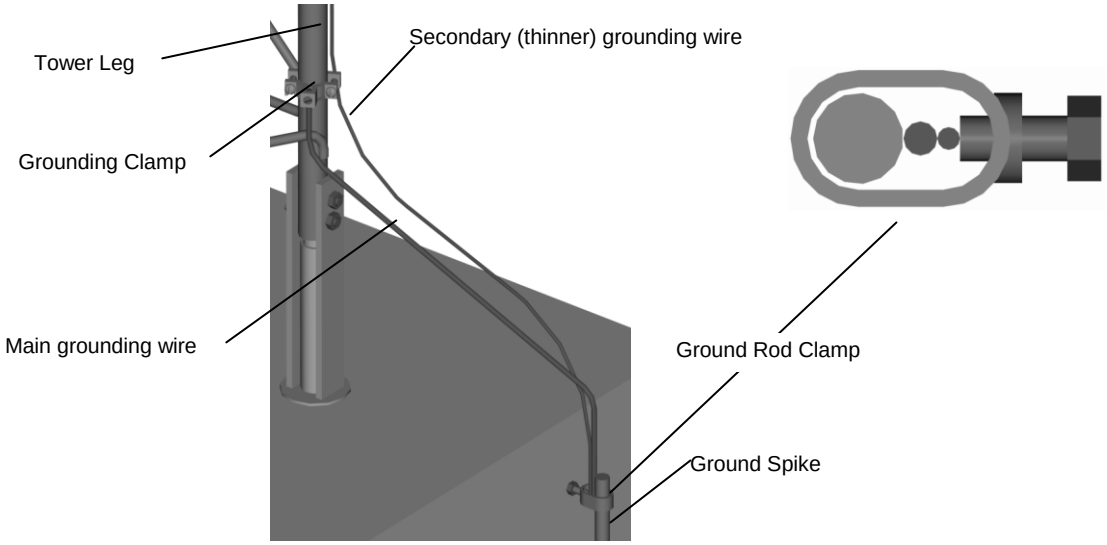

Figure 2-12 Grounding the Datalogger and the Tower

WARNING **The grounding system supplied with the weather station is designed to give the system protection against induced transients and secondary lightning discharges. While the system does offer some protection against lightning damage, if the weather station is installed at a site where frequent direct lightning strikes are likely, Campbell Scientific recommends that you seek the advice of a specialist lightning protection company.**

2.10 Maintenance

2.10.1 Enclosure

1. Referring to the *ENC 10/12, ENC12/14 and AM-ENC Enclosures Installation Manual*, seal the cable gland if it is used for cable entry.

CAUTION Do not use bath or tile sealant, which gives off corrosive fumes that can damage circuit boards. Use proper electronic grade silicone rubber or plumber's putty.

2. Place desiccant in the enclosure as described in the *Enclosures Installation Manual*.

CAUTION

Failure to use or exchange the desiccant may lead to condensation inside the enclosure. Not only will this lead to corrupted data, but, in the long term, can also cause corrosion which is expensive to repair.

If there will be an extended time between maintenance visits, we strongly recommend that extra desiccant packs are purchased and placed in the enclosure to ensure that it remains moisture free – *see the Enclosures Installation.*

2.10.2 Rust Prevention

Spray rustproofing compound over all bolts, joints and any exposed threads. Also apply to any crevices where water may settle, especially around the eyebolts. Exposed steel legs may be treated, but take care that any drainage channels from the aluminium legs are not blocked.

This process must be repeated annually, if necessary repainting the steel base with rust resistant paint.

CAUTION

Do not allow contact between rustproofing compound and the datalogger or sensors. In particular, avoid spraying the compound close to the humidity sensor.

Also ensure that water can drain effectively from the aluminium tubing of the tower to prevent water traps and possible damage from freezing. See Section 1.

2.10.3 Inspection

After a few days check that the tower is secure and level. Check the guy wires (where fitted) and all bolts.

At least every year (and preferably every six months) check the tower, for tilting and damage; check all guy wires (where fitted) and reapply rustproofing compound as before, especially around the eyebolts.

The desiccant pack in the enclosure should be changed or dried out at an interval which depends on how frequently the enclosure door is opened. Drying may be done by placing in an oven at 120°C for 16 hours. In general the desiccant will last as long as a set of alkaline batteries (4-6 months) if the door is opened for a few minutes each week. More frequent inspections of the datalogger or operation in very wet or humid conditions may require more frequent changing of desiccant. A mineral desiccant is recommended and can be supplied upon request.

2.10.4 Sensors

Please refer to individual sensor manuals for maintenance and calibration procedures.

High-Level Sensors

To thoroughly check and maintain sensors mounted at a high level, you will have to tilt the tower to the ground to access the sensors. This is done as follows:

1. Loosen the turnbuckle on the guy wire (where fitted) at the rear of the tower (i.e. in the direction of tilt), and slip the guy wire from the anchor bolt.
2. Remove *both* the bolts holding the rear leg into the base section.

3. Remove the *lower* bolts in the other two legs, and loosen the upper bolts in these legs just enough to allow the tower to be tilted when a small amount of force is applied.
4. Gently lower the tower to the ground, supporting and packing the structure as necessary to avoid damage to the sensors or other delicate equipment.

When the tower is safely on the ground you can check and maintain the sensors or any other equipment as required. If re-alignment of sensors is necessary, you may have to remove the top section of the mast and proceed as outlined in Section 2.3 of this manual.

After all necessary maintenance has been carried out, re-erect the tower following the procedures given in Section 2.6. Re-check all three guy wires for security and carry out any other maintenance such as rust prevention as detailed above.

Low-Level Sensors and equipment

If you have lowered the tower for maintenance of the high-level sensors as detailed above, you may wish to check all other equipment at the same time.

Alternatively sensors and the enclosure etc. which are mounted at a lower level, but which may be above head height, can be maintained by using a suitable stepladder.

Section 3. Programming

This section describes how to program your AWS, either by using Campbell Scientific's `point-and-click' program building software Short Cut (part of PC200W), or, for more experienced programmers, by using Edlog or the CRBasic Editor, part of the more advanced Datalogger Support packages, PC400 or LoggerNet.

3.1 Introduction

Your standard AWS will normally be programmed using Short Cut, an easy to use program builder, which is part of Campbell Scientific's datalogger support software package, PC200W. Short Cut covers all of the standard sensors and produces a wiring diagram which should always be used when wiring up your sensors and peripherals. The use of Short Cut and the PC200W software is fully explained in the PC200W User Guide.

If you are a more experienced datalogger programmer, and the programs provided by Short Cut do not fully meet your needs, for example if you wish to use a `non-standard' sensor, then you can write or edit your own programs using the Edlog or the CRBasic program editor which is part of the optional PC400 and LoggerNet datalogger support software packages. The new or edited program can then be downloaded to the datalogger as described below.

3.1.1 Programming

After installing the software as described in the User Guide, use the datalogger program as follows:

1. Set up the link between your PC and the datalogger. The simplest method is a direct link using the SC32B opto-isolated interface or an SC929 Interface Cable. Refer to the manuals for the interface you are using for connection details. No separate interface is required for the CR23X, CR3000 or CR1000.

   If you intend to use a different link (such as a telephone or short-haul modem) consult the instruction manuals for the appropriate device.

2. Turn on the datalogger. For a datalogger with the PS100E power supply, connect the power using the in-line connector between the power supply and the datalogger. (The lead-acid battery in a PS100E-LA is also shipped disconnected and should be plugged into the charger circuit.)

   The PS100E-LA supply has a power switch under the battery cover.

   After turning the datalogger on, leave it for at least one minute to complete its power-up tests (see datalogger manual for details of power-up sequence).

3. Use the communications setup in PC200W/PC400/LoggerNet to call the AWS as described in the appropriate software manual.

4. Also use the appropriate function of PC200W, PC400 or LoggerNet to download the datalogger program you created earlier to the AWS.

5. Use the other functions of the software as required. For example, you can set the datalogger clock and monitor the sensor readings to verify that the sensors have been installed correctly. See the appropriate software manual for details.

6. If you want to amend or edit the program use Short Cut, CRBasic or Edlog as appropriate.

NOTE Full details of all the functions of PC200W/PC400 or LoggerNet are contained in the User Guide for the software.

Campbell Scientific dataloggers can be programmed from a computer without using the datalogger support software by using telecommunications commands. However, this is not normally necessary and is not recommended as a general method of datalogger programming.

Appendix A. Using True North for Accurate Wind Measurements

To get optimum wind direction data from your weather station, it is recommended that you set up your wind direction sensor with reference to true north (rather than magnetic north). This Appendix provides some additional information about using true north.

A.1 Magnetic Declination

Magnetic declination is sometimes referred to as the magnetic variation or the magnetic compass correction. It is the angle formed between true north and the projection of the magnetic field vector on the horizontal plane. Magnetic declination varies according to geographical location. In the UK, for instance, it changes by over eight degrees from the most Easterly to the most Westerly points. Also, the magnetic pole tends to wander or drift, so its location can change over time. Therefore it is recommended that wind direction measurements are made with reference to *true* north.

A.2 Determining True North

The difference between true and magnetic north is easily corrected by adding or subtracting the difference between the two readings as explained below. Maps are always drawn in relation to the *true* north pole, and ordnance survey maps will normally show the offset or declination angle between true and magnetic north.

To find *true* north bearing for a specific site do the following:

1. First establish the declination angle (or offset) between magnetic and true north, usually from an ordnance survey map, as described above.
2. Establish the position of magnetic north accurately, using a good quality compass.
3. Add (or subtract) the declination angle to find the position of true north for your site. (In the UK the declination angle from magnetic to true north will always be to the east, and so will be *added* to the magnetic north value, as shown in Figure A-1, below.)

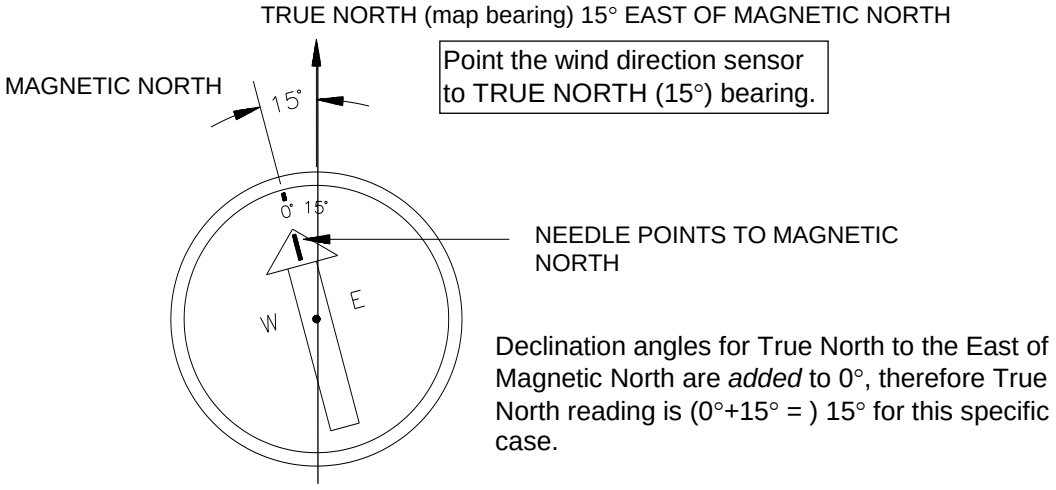

Figure A-1 Declination Angles – True North to East of Magnetic North

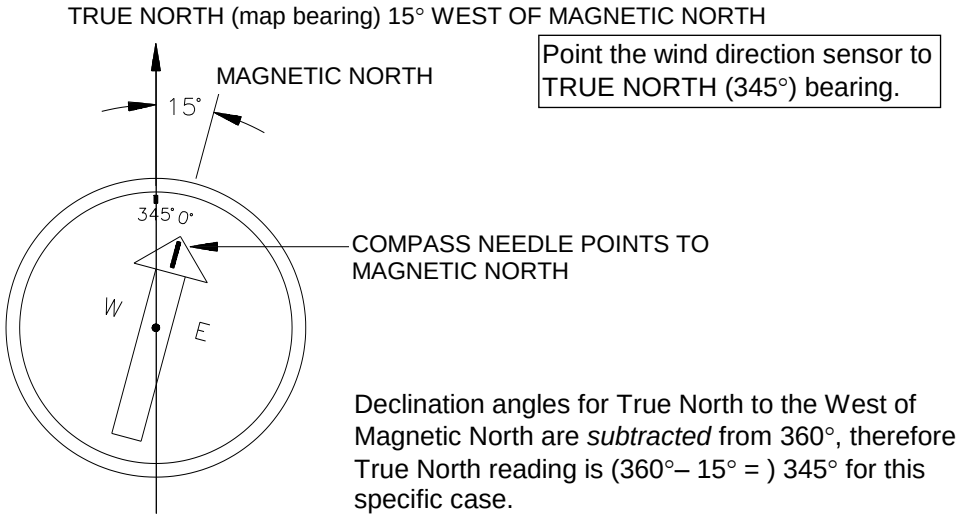

Figure A-2 Declination Angles – True North to West of Magnetic North

NOTE For UT920/UT930-based weather stations, firstly determine the declination angle. Use this value in conjunction with the magnetic north bearing to set the wind sensor to true north as explained in Section 2.3 of this manual.

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