PROVEN

ENERGY

PROVEN 6
TM900/TM1500

GRID CONNECT
INSTALLATION MANUAL
(PROVEN6-300-2006REV.01)

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Table of Contents

1.0 Introduction

1.1 Package Contents

It would be highly appreciated if you could check the contents of your delivery package against the accompanying delivery note to ensure it has all the parts and in their right quantities as listed. Thank you.

Trailer conveying turbine package

1.2 Health and Safety Information

Please refer installation and servicing to qualified service personnel only. High currents are produced by this wind turbine system and incorrect installation or use may result in

- risk of electric shock or fire
- mechanical damage

Warning!

Installation of the turbine involves handling heavy components such as the turbine nacelle, blades and covers. Appropriate lifting gear, techniques and appropriate number of personnel should be used at all times.

Personal Precautions

Proven recommends a two person team as a minimum for mechanical installation of a Proven Wind Turbine – they should use standard protective clothing. Use only certified lifting straps and strops.

Weather

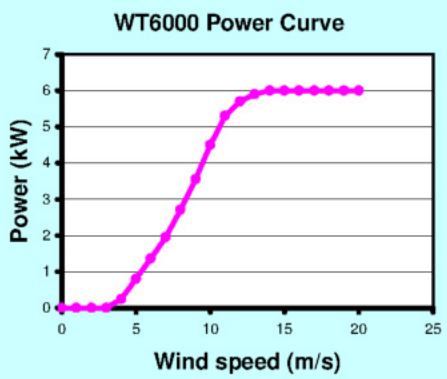
The turbine should be installed in periods of wind speeds less than 12 m/s (25 mph or 43 km/h) and generally calm weather conditions.

Proven 6; 6kW Wind Turbine

Proven TM900/TM1500, 9m/15m Un-Guyed Mast

Proven Patented Furling

In winds above 12m/s (25mph) the blade twist to limit the power in response to high rpm.



Marine Build Quality

All turbines are manufactured with galvanised steel, stainless steel or plastic.

Performance	
Cut - in Wind Speed	2.5 metres/second (5.6 mph)
Cut - out Wind Speed	>70 metres/second (>155 mph)
Rated Wind Speed	12 metres/second (26 mph)

Rotor	
Type	Downwind, Self - Regulating
Number of Blades	3, Flexible
Blade Material	Glassthermoplastic Composite
Rotor Diameter	5.5 metres
Rated RPM	200
Rotor Thrust (kN)	10

Generator	
Type	Brushless, Direct Drive permanent Magnet (No gear-box, zero maintenance)
Output	Grid connect (300V DC 50Hz or 300V DC 60Hz), Battery Charging (48V DC), Direct Heating (240V Switch DC)
Rated Power	6000 watts
Annual Output	6,000 - 12,000 kWh depending on site

Low Speed Equals Durability

Low rotor speed (half of the speed of comparable machines) ensures extended durability of blades and bearings. It also means that Proven WTs are the quietest in the world!

Mast	
Type	Tapered, Hinged, Self Supporting
Hub Height	9m or 15m
Foundation	2.5x2.5x1m^3 (TM900) or 3x3x1.2m^3 (TM1500) Concrete

Noise	all readings taken with an ATP SL-25 portable meter
45dB	At 5m/s
65dB	At 20m/s
70-80dB	Car 15m away speeding at approx 40mph (18m/s)

Weight	
WT6000	600 kg
TM900	360 kg
TM1500	656 kg

Sample of Commercial Customers

British Telecom/Scottish Youth Hostel Association/Saudi Aramco/Irish Lighthouse Authority/Welsh Water/British Rail/Shell Exploration/T-mobile/Orange

Electrical Installation

2.0 Electrical Installation

The Proven 6/300 is specially designed for connection to LV network at 230Vac 50Hz nominal by means of the WB-6000 or WB-3000 grid connect inverter (SMA Windy Boy). It is suitable for domestic, agricultural and SME applications and will produce from 6 – 12 MWh per annum depending on the wind resource available. A description of the main electrical component parts of the system is as follows:

2.1 Schematic for Connection

Please refer to the electrical schematic. The main elements are

- Proven 6 wind turbine containing GW6000 3-phase AC synchronous variable speed alternator
- Proven grid connect inverter & controller package comprising
  - DC Disconnect – allowing the turbine to be isolated from the grid connect inverters.
  - ECM6004ME/300 controller which displays turbine voltage and current, rectifies AC input from the turbine and outputs DC power to the grid connect inverters
  - 1 x WB-6000 6kW or 2 x WB3000 SMA Windy Boy grid connect inverters of the self commutating static type.
- AC Disconnect Lockable – allowing the grid to be securely isolated from the inverter(s).

The output from the AC lockable disconnect is normally connected to a spare fuse or breaker at the customer distribution board rated at >32A.

2.2 GW6000

The Proven 6 contains a purpose built permanent magnet generator which is directly driven by the rotor at variable speed according to wind conditions. All of the technical information on the GW6000 below is provided for information only – the only bit of the system that is "seen" by the grid system is the grid connect inverter (see following sections).

2.2.1 Type of Generator

The GW6000 is a permanent magnet synchronous 3-phase AC alternator suitable for variable speed operation.

2.2.2 Selected Operating Characteristics

The output voltage open circuit is proportional to RPM of the turbine. The output voltage during normal operation is dependent on the load placed on the generator.

The output of the generator is connected to the ECM6004ME/300 control box which contains a 3-phase rectifier.

GW6000	RPM	Approx Wind Speed	GW6000 Output Voltage Vac under normal operating conditions Vop AC	GW6000 Output Voltage Vac if grid fault (inverters disconnected from grid) Voc AC	Input DC Voltage to grid connect inverter under normal op condition s Vop Dc	Input DC voltage to grid connect inverter if grid fault (inverters disconnected from grid) Voc DC
Minimum Speed	0	0-5 mph	0	0	0	0
Maximum Speed	200 rpm	>25mph (blades feather at higher wind speeds to maintain this max shaft rpm)	225Vac 3-ph	450Vac 3-ph	300V DC	540V Dc
Typical Speed (during operation)	100-200 rpm	5-25mph	200 – 225 Vac 3-ph	400 – 450 Vac 3-ph	240-300V DC	480 V DC – 540 V DC

There are no touching parts or brushes in the machine and it is maintenance free. The GW6000 has 12 poles and has a nominal AC frequency of 20Hz @ 200 rpm.

The generator can be disconnected at any load without any problems – in this case the winding voltage rises and the turbine will speed up slightly until the blades mechanically govern to the maximum rpm. On reconnection of load, the turbine winding voltage will fall gradually to normal operating value due to the intelligent switch-on strategy of the inverters used (after the switch on delay period has passed).

2.3 ECM6004ME/300 Control Box

The ECM6004ME/300 has the following functions

- Converts output 3-phase AC variable voltage of the turbine to DC variable voltage for input to the grid connect inverters.
- Isolation point for the turbine.
- Displays V, I (DC) from the turbine.

2.4 WB-6000/WB-3000 Grid Connect Inverter

The WB-6000/WB-3000 grid connect inverter has the following functions

- Conversion of variable voltage DC input to synchronised 230Vac 50Hz nominal
- 180s delay after grid fault until re-connect to grid
- Trip out on over/under voltage
- Trip out on over/under frequency

The WB-6000/WB-3000 inverter has been type tested for suitability for use under G83/1 regulations.

2.4.1 Description of Typical System Commissioning Procedure

At the start of a typical commissioning procedure the following should be the situation

- The turbine is mechanically braked
- The turbine is isolated from the grid connect inverters
- The grid connect inverter is isolated from the grid

The typical start up sequence is:-

- Connect the 3 phase ac supply from wind turbine to the inverters by switching on the 3 pole disconnect in the ECM6004ME/300 controller.
- Release the wind turbine mechanical brake. The turbine starts to rotate if wind conditions are more than about 5mph. The inverter waits until input DC voltage is >250V before starting its self test and safety procedures at which point the ORANGE LED on the front of the inverter will flash approx once per second.
- Connect the inverters to grid AC by turning the lockable AC disconnect to the On position. At this point the inverters start monitoring grid AC voltage, frequency and impedance. After a few seconds the GREEN LED starts to flash. First the inverter checks voltage and frequency are within allowed ranges and that grid impedance is >1.25Ω. If all is OK then it waits 180 seconds (required by G83 and G59) and then starts its "connect to AC network" procedure. After completion of this procedure (will take approx 5 mins depending on wind conditions the GREEN LED will be continuously on.
- If the inverter input DC voltage is <180VDC for >300 seconds then there is not enough wind power available and the inverter shuts down and goes into sleep mode (All LEDs off).. Higher input DC voltages will wake it up when wind speeds increase and it will then repeat this connection procedure.

2.5 Description of Typical System Operation

A typical operating strategy during a **windy period** is summarised by:-

- Continuous and automatic monitoring of Vac and fac by the inverter.
- Inverter will disconnect from grid network in <0.5 seconds should V_{ac} or f_{ac} go out of their allowed ranges under the connection settings chosen.

- Inverter continuously adjusts output AC amps to match the wind energy available.

A typical operating strategy during a **calm period** is summarised by:-

- Inverter goes into sleep mode after disconnecting from grid network.
- If wind increases then the inverter will start up as described in the commissioning section 4.4 above.

A typical operating strategy during a loss of mains is summarised by:-

- Inverter disconnects from grid network in < 0.2s and monitors V_{ac} and f_{ac} continuously. At this point the wind turbine will speed up slightly and the generator winding voltages will rise as described in section 4.1.2.
- Should V_{ac} and f_{ac} return to allowed ranges then the inverter will start up as described in the commissioning section 4.4 above.

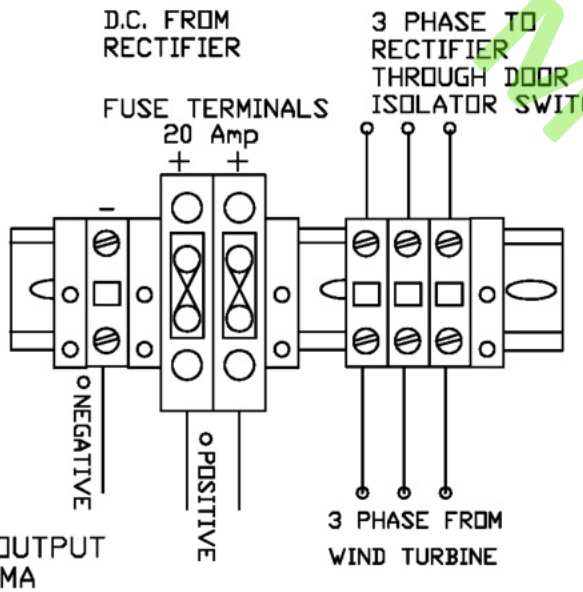
2.6 Method of Disconnection from Grid

The WB-6000/WB-3000 inverter contains an independent disconnection device consisting of the following

- Excerpt from WB-6000/WB-3000 manual:- *"For maximum safety this independent disconnection device consists of two separate MSDs (Mains monitoring with allocated Switching Devices) that are connected in series. Each of these MSD constantly monitors the grid quality by checking the frequency, voltage and impedance. The redundant circuit and and automatic self test on each system start up ensure a reliable function of the disconnection device."* For use with a wind turbine or solar system this means that the disconnection device will be tested around 1-10 times per day on average.

- The allocated switch device for the MSDs is the Matsushita DE1A 16A single pole relay. One relay is provided Live and one for Neutral. The MSDs are energised from the dc source (wind or solar power). In the case that there is no wind or solar power then the MSDs are unpowered and the relay status is open/safe.

PANEL LAYOUT



ZONE	REV	DESCRIPTION REVISIONS	DATE	APPROVED
	-	-	-	-
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	-	-	-	-

PROVEN ENERGY

PREPARED BY PH

CHECKED BY GSu

Drawing Title: PANEL LAYOUT

FSCM NO.

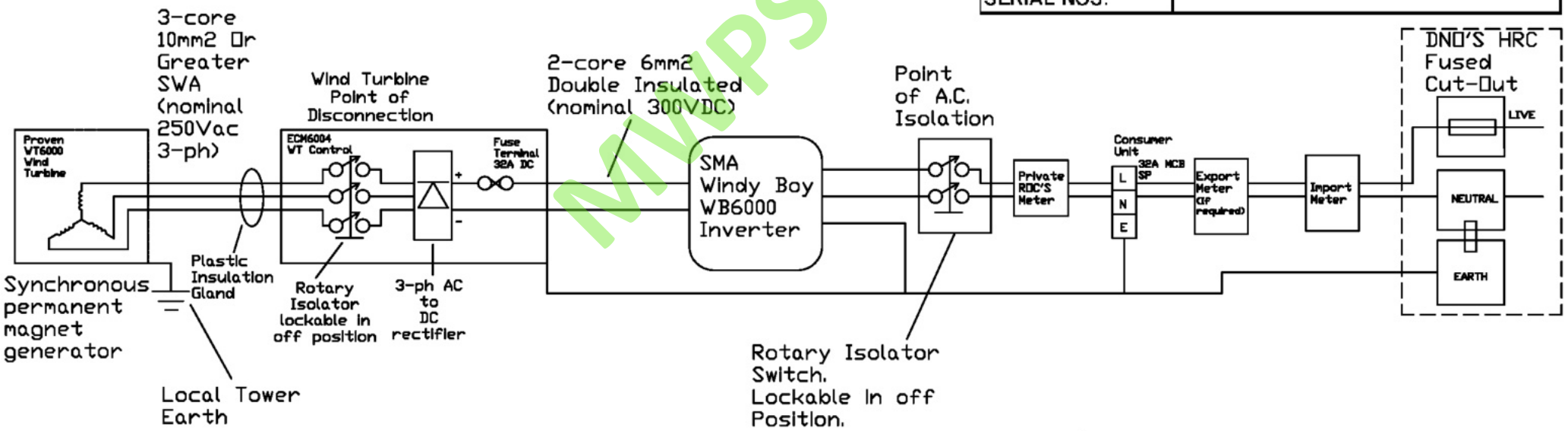
DWG NO. 6000 EE 005 rev3

REV 2

SCALE N/A Date APRIL 2002 SHEET

Schematic for TN - C - S (PME) System Using a Proven WT6000

CUSTOMER NAME:	
SITE ADDRESS	
SMA INVERTERS	
SERIAL NOS.	



NOTES.

1) Wind turbine output is nominal 250Vac 3ph under normal operating conditions 20Hz but voltage, current and frequency proportional to rpm/wind speed. Open circuit voltage approx 2 x normal operation. Max output 6kW at approx 200 rpm.

2) SMA Windy Boy WB6000 Inverter is EA approved for connection to UK grid. It includes

a) over/under voltage protection
b) over/under frequency protection
c) loss of mains protection (by means of frequency drift)
d) 180s delay from return of mains after fault to start of self initialisation procedure.

WINDYBOY CONTROL SETTINGS (G83/1)		
	VALUE	
OVER VOLTAGE	264	V
UNDER VOLTAGE	209	V
OVER FREQUENCY	50.5	HZ
UNDER FREQUENCY	47.5	HZ
DISCONNECTION LOSS OF MAINS	0.2	SECS

ZONE	REV	DESCRIPTION REVISIONS	DATE	APPROVED
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	-	-	-	-
	-	-	-	-

PREPARED BY KA | CHECKED BY RC

DWG NO. Schematic with Protection Settings 6000w.dwg | REV 4

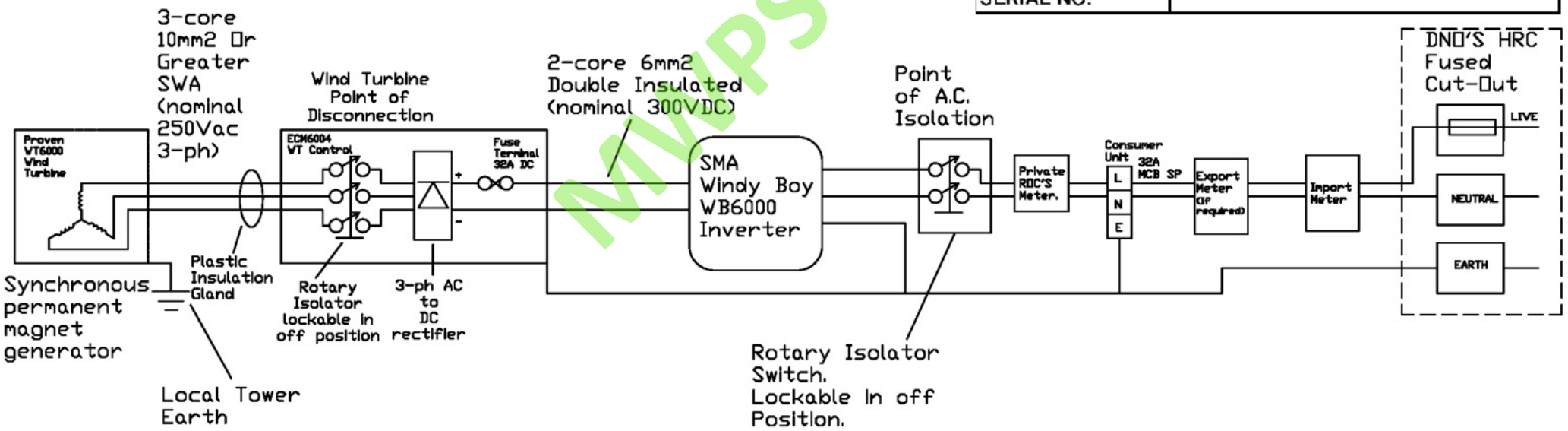
SCALE | DATE 13/06/07 | SHEET

PROVEN PROVEN ENERGY

GDC6004 6kW Windy Boy Grid Connect Inverter Electrical Schematic with protection settings.

Schematic for TN - S (Cable Sheath) System Using a Proven WT6000

CUSTOMER NAME:	
SITE ADDRESS	
SMA INVERTER SERIAL NO.	



NOTES.

1) Wind turbine output is nominal 250Vac 3ph under normal operating conditions 20Hz but voltage, current and frequency proportional to rpm/wind speed. Open circuit voltage approx 2 x normal operation. Max output 6kW at approx 200 rpm.

2) SMA Windy Boy WB6000 Inverter is EA approved for connection to UK grid. It includes

a) over/under voltage protection
b) over/under frequency protection
c) loss of mains protection (by means of frequency drift)
d) 180s delay from return of mains after fault to start of self initialisation procedure.

WINDYBOY CONTROL SETTINGS (G83/1)		
	VALUE	
OVER VOLTAGE	264	V
UNDER VOLTAGE	208	V
OVER FREQUENCY	50.5	HZ
UNDER FREQUENCY	47.0	HZ
DISCONNECTION LOSS OF MAINS	0.2	SECS

ZONE	REV	DESCRIPTION REVISIONS	DATE	APPROVED
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	-	-	-	-
	-	-	-	-

PREPARED BY KA | CHECKED BY RC

DWG NO. Schematic with Protection Settings 6000w.dwg | REV 3

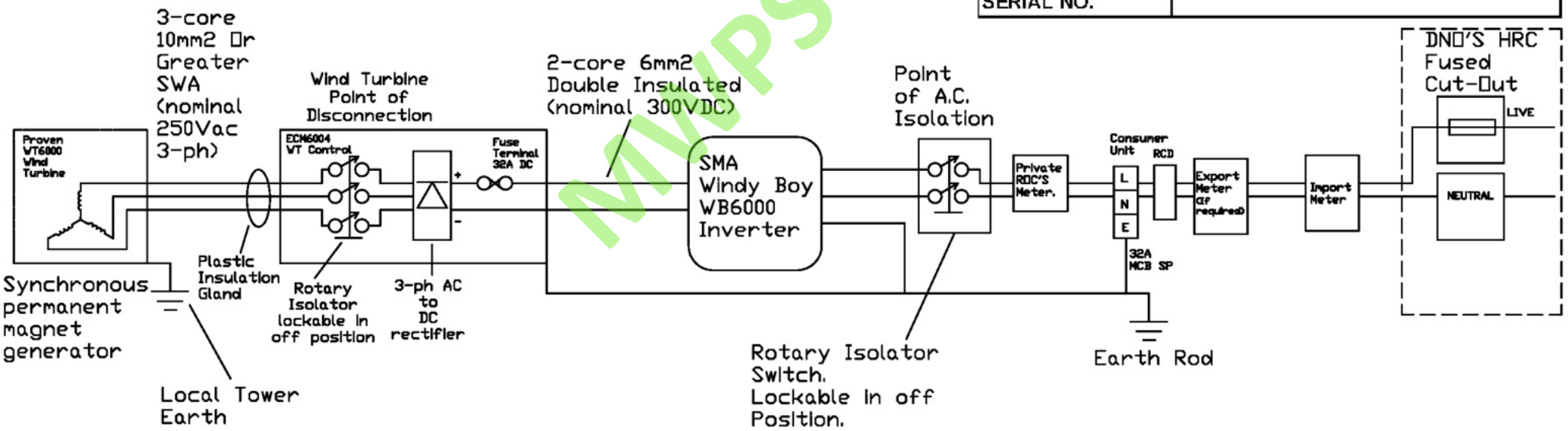
SCALE | DATE 15/06/07 | SHEET

PROVEN PROVEN ENERGY

GDC6004 6kW Windy Boy Grid Connect Inverter Electrical Schematic with protection settings.

Schematic for TT (RCD) System Using a Proven WT6000

CUSTOMER NAME:	
SITE ADDRESS	
SMA INVERTERS SERIAL NO.	



NOTES.
1) Wind turbine output is nominal 250Vac 3ph under normal operating conditions 20Hz but voltage, current and frequency proportional to rpm/wind speed. Open circuit voltage approx 2 x normal operation. Max output 6kW at approx 200 rpm.
2) SMA Windy Boy WB6000 Inverter is EA approved for connection to UK grid.
It includes
a) over/under voltage protection
b) over/under frequency protection
c) loss of mains protection (by means of frequency drift)
d) 180s delay from return of mains after fault to start of self initialisation procedure.

WINDYBOY CONTROL SETTINGS (G83/1)		
	VALUE	
OVER VOLTAGE	264	V
UNDER VOLTAGE	209	V
OVER FREQUENCY	50.5	HZ
UNDER FREQUENCY	47.0	HZ
DISCONNECT ON LOSS OF MAINS	0.2	SECS

ZONE	REV	DESCRIPTION REVISIONS	DATE	APPROVED
	-	-	-	-
	-	-	-	-
	-	-	-	-

PREPARED BY KA | CHECKED BY RC

DWG NO. Schematic with Protection Settings 6000w.dwg | REV 4

SCALE | DATE 15/06/07 | SHEET

PROVEN PROVEN ENERGY

GDC6004 6kW Windy Boy Grid Connect Inverter Electrical Schematic with protection settings.

A1100

Electronic Polyphase Meter

Advanced, cost-effective polyphase metering...

Features

- Accuracy Class 1 or Class 2
- kWh import or kWh import/export
- 3 phase, 4 wire or 3 phase, 3 wire
- 16 year product life
- Large figure display
- Extensive security data
- IrDA (Infrared Data Association) output for transmitting billing, security and status data
- 12kV impulse withstand
- Compact design
- Double insulated, glass filled polycarbonate case to DIN 43857 Part 2 and Part 4 (except for top fixing centres)
- IP53 in accordance with IEC 60529:1989

Options

- Liquid Crystal Display or mechanical stepper register
- One or two rates controlled by an external device (LCD meter only)
- Auxiliary terminals configured for rate selection (two rate meters), pulsing output or serial data output
- SO pulsed output (IEC 62053-31)
- Extended terminal cover with or without cut-out
- CT or direct connected

The use of innovative metering technology provides cost-effective metering that is highly secure and maintains a high degree of accuracy over its full operating range. The A1100 meter is suitable for CT or direct connected, domestic, commercial and light industrial polyphase applications.

Two main versions of the A1100 meter are available. The liquid crystal display version of the meter can be supplied as a one or two rate meter. The meter is available as import only or import and export. The display has a customer defined display sequence that can include security information. Chevrons and legends on the nameplate identify the data being displayed.

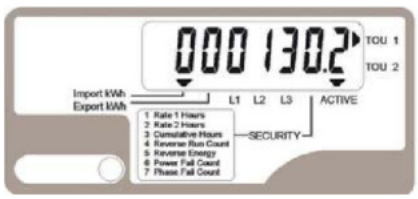
The mechanical register version of the meter is available for kWh import one rate applications only. Five LED's are used to identify the status of the meter.

Communications are provided via the IrDA port allowing the meter registers and security data to be read electronically using a hand-held device. This greatly reduces the possibility of manual meter reading errors. As an option the same absolute data as the IrDA port, or a pulsed output, can be transmitted via the meter's auxiliary terminals.

Meters can be supplied to meet accuracy Class 1 or Class 2 requirements. They are approved to EN 61036:1996 plus Amendment 1 2000 and have an ingress protection of IP53 to IEC 60529:1989.

ELSTER

Display



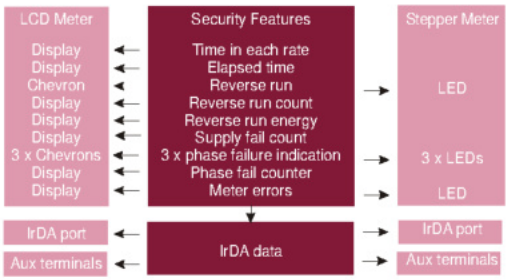
The LCD version of the A1100 displays register and security information by the use of chevrons and digits. The mechanical register version has five LED's for reporting status information.

Meter nameplates can be printed in any language.

Security

The A1100 offers high security with many useful security features. The meter stores all registration and configuration data to non-volatile memory. All data is retained for the life of the meter.

Recordable security features are illustrated below.



As an option the kWh register can increment in power flow insensitive mode i.e. it increments regardless of energy flow direction.

Pulse Output

An opto-isolated pulse output can provide the basis for an energy management system or AMR. These pulses are output via the meter's auxiliary terminals. The output conforms to IEC 62053-31.

System Connections

2 Element	3 phase 3 wire
3 Element	3 phase 4 wire 2 phases of a 3 phase 4 wire 2 phase 3 wire 1 phase 3 wire 1 phase 2 wire (LCD meter only)

IrDA Communications

The IrDA (Infrared Data Association) communications port provides one way communications, transmitting a continual data stream from the meter to an external device. An error checking algorithm protects the integrity of the data. As an option the same absolute data is available via the meter's auxiliary terminals. The port uses the OBIS: IEC 62056-61 data identifiers.

Important information is provided:

Meter registers	Security features
Status information	Identification

The port transmits over a distance of 250mm.

Technical Data

Current Range	10-100A, 5-85A (direct), 5A-10A (CT)
Voltage Range	220-240V (L-N) or 220-240V (L-L)
Frequency	50 Hz
Burden	
Voltage Circuits (230V)	0.9W, 9VA capacitive burden/phase [max]
Current Circuits	2VA @ 100A/phase [max]
Insulation	4kV RMS 50Hz
Impulse Withstand	12kV 1.2/50µs 500ohm source
Display LCD	9.8 x 3.5mm characters High contrast, wide angle
Stepper Motor	6.7 x 3.5mm characters
IrDA Baud Rates	2400, 4800 or 9600 (Without serial port)
Serial Baud Rates	2400 or 4800
Product Life	16 years
Certified Product Life	10 years
Temperature	-40° to + 55° C (Operational range) -40° to + 85° C (Storage)
Humidity	Annual mean 75% (For 30 days spread over one year, 95%)
Pulse Width	10 to 250ms or equal mark/space
Wh/pulse	1, 2, 4, 5, 10, 20, 25, 40, 50, 100
Weight	860 grams
Specifications	kWh Class 1 or 2 IEC 61036:1996 (plus Amendment 1:2000)
Case	IP53 to IEC 60529:1989

Dimensions and Fixing Centres

Elster Metering Systems
Staffordshire,
United Kingdom
Tel: 44 (0) 1785 812111
www.elstermetering.com

EMS/A1100/2.2004

A100C

BS Electronic Single Phase Meter

Compact yet advanced domestic metering...

Features

- Accuracy Class 1 or Class 2
- kWh import or kWh import/export
- 20 years certified life
- Large digit (9.8mm) multilingual display with chevron information indication
- Extensive security data
- Communications as standard
- 12kV impulse withstand
- High security, compact design (130mm Wide x 97mm High x 47mm Deep)
- BS double insulated, glass filled polycarbonate case
- Permanently fixed main cover
- IP53 in accordance with IEC 60529:1989

Options

- One or two rates controlled by external device
- IrDA communications or IEC 62056-21 (formerly IEC 61107) optical communications
- Auxiliary terminals configured for:
  - SO Pulse output (IEC 62053-31)
  - Serial data output (IrDA meter)
- A102C - kWh and kvarh energy measurement
- Extended terminal cover

The successful range of A100 meters from Elster Metering Systems provide a cost effective solution for one or two rate domestic applications. The new A100C meter is housed in an extremely compact case. To further enhance security, the main meter cover is permanently secured to the base during the manufacturing process. The meter also provides the choice of IrDA communications or optical IEC 62056-21 (formerly IEC 61107) communications.

The liquid crystal display has large (9.8mm), high contrast characters that can be viewed from a wide angle. Chevrons and multilingual legends on the nameplate identify the values being displayed. The energy registers can be configured for the required number of digits and for the position of the decimal point.

The A100C offers high security and detects many of the most commonly used tamper techniques. Security features of the meter include reverse run energy total and count; power fail and elapsed time count; hours in anti-creep; hours in Rate 1, Rate 2 and hours since last power up time. These are stored as security data and can be included as part of the display sequence and read via the optical communications ports.

The A100C has the option of IrDA or optical IEC 62056-21 (formerly IEC 61107) communications. Both methods of communication allow the meter registers and security data to be read electronically from a laptop or hand-held device, greatly reducing the possibility of manual meter reading errors.

The A100C can be a simple import meter or for import/export for domestic or small scale generation sites. The meter offers one or two rate operation. The rate select for the two rate meter is switch to neutral.

The A102C measures reactive energy in addition to active energy and is ideally suited for utilities who wish to bill or monitor energy consumption based on kvarh measurement. The meter can measure import or import and export energy.

Meters can be supplied to meet accuracy Class 1 or Class 2 requirements. They are approved to EN 62053-21:2003, have an ingress protection of IP53 to IEC 60529:1989 and comply with EMC standard EN 50081-1:1992.

ELSTER

Display

The liquid crystal display is programmable to meet a customer's requirements. A typical display for an A100C meter showing kWh import is shown. The chevrons and index digit indicate the information being displayed. The nameplate information can be printed in any language.

Security Data

The A100C offers many useful security features. The meter stores all registration and security data to non-volatile memory. This data can be shown on the display. All data is retained for the life of the meter. Recordable security features are listed below.

- Reverse run event count
- Reverse run energy total
- Reverse run indication on LCD
- Power fail count
- Elapsed time count
- Time in rate 1 and rate 2
- Hours since last power-up
- Hours spent in anti-creep

As an option the kWh register can increment in power flow insensitive mode i.e. it increments regardless of energy flow direction.

Communications

Optical Port

IrDA Port

The A100C has the option of IrDA (Infrared Data Association) data stream communications or optical IEC 62056-21 (formerly IEC 61107) two way communications. The table below shows the functions available for each type of communications.

	Configure Meter	Register, Security and Status Data Via Optical Port	Register, Security and Status Data Via Auxiliary Terminals
IEC 62056	Yes	Yes	No
IrDA	No	Yes	Yes

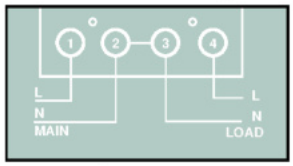
Pulse Output

An opto-isolated pulse output can provide the basis for an energy management system or AMR. These pulses are output via the auxiliary terminals.

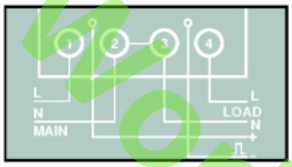
Technical Data

Current Range	10-100A, 20-100A
Voltage Range	210-250V, 105-127V
Frequency	50 or 60Hz
System Connection	1 phase, 2 wire
Burden (230V)	0.66W, 8.5VA (Capacitive burden)
Insulation	4kV RMS 50Hz
Impulse Withstand	12kV 1.2/50µs 40ohm source
Display	9.8mm x 3.5mm characters, High contrast, wide angle
IrDA Baud Rates	2400, 4800 or 9600 (Without serial port)
IEC 62056-21 Rate	9600
Serial Baud Rates	2400 or 4800
Certified Product Life	20 years (OFGEM model)
Temperature	-20° to +55°C (Operational range) -25° to +85°C (Storage)
Humidity	Annual mean 75% (For 30 days spread over one year, 95%)
Pulse Output	100ms pulse 100p/kWh (=10Wh/pulse) (Other pulse rates, durations available)
Weight	345 grams
Specifications	kWh Class 1 or 2 EN 62053-21:2003 kvarh Class 2 or Class 3 En 62053-23
Case	IP53 to IEC 60529:1989

Terminal Arrangements

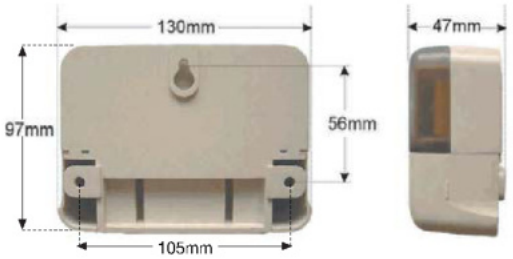


Single Rate



Pulsed Output

Dimensions and Fixing Centres



Elster Metering Systems
Staffordshire,
United Kingdom
Tel: 44 (0) 1785 812111
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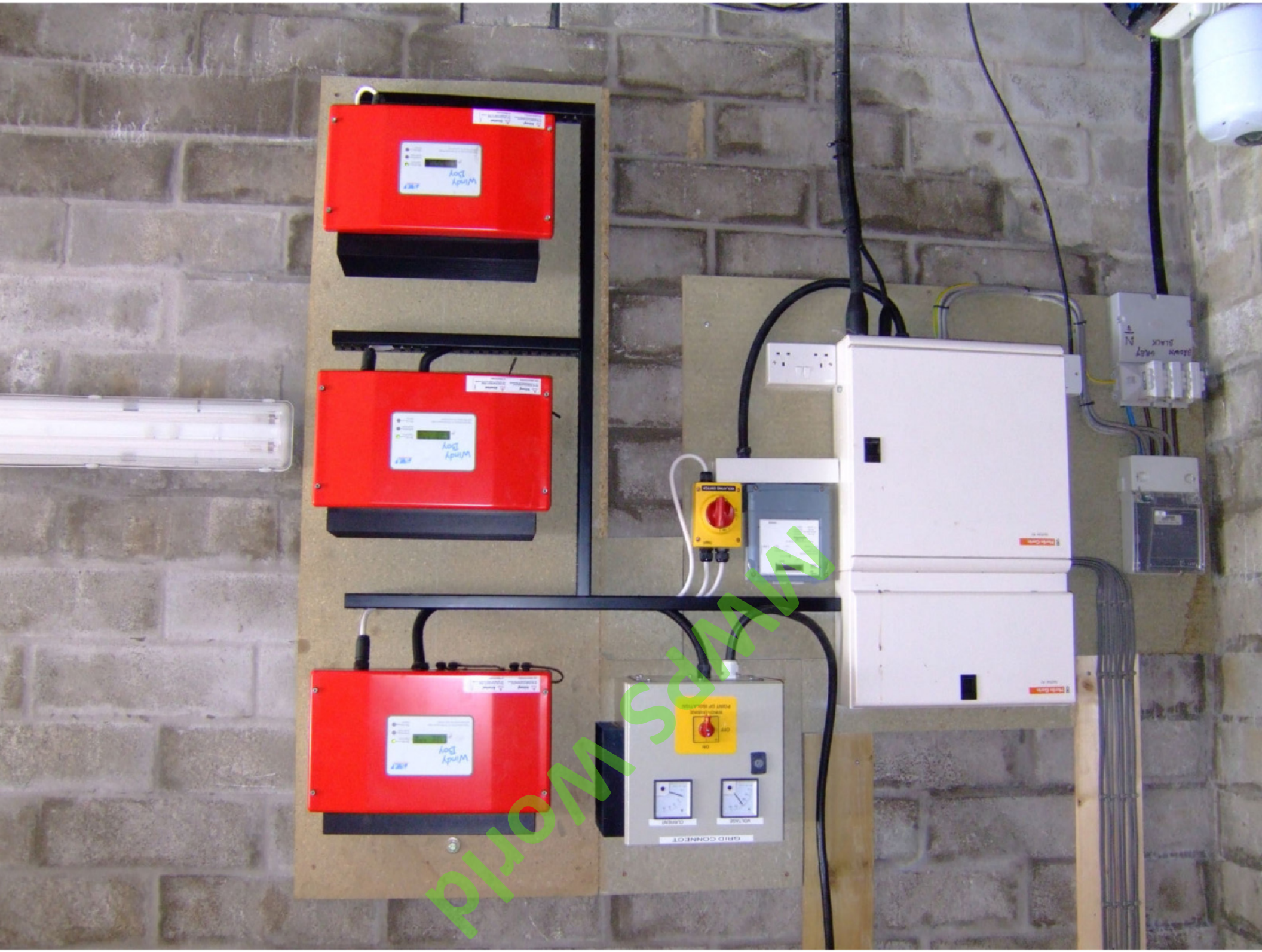
MWPS World


Windy Boy
Windy Boy
GRID CONNECT
VOLTAGE
CURRENT
ON
OFF
DANGER
400 Volts


Windy Boy
Windy Boy
Windy Boy
GRID CONNECT
MWPS World

PROVEN 6 INSTALLATION USING A WINDY BOY 6000

PROVEN PARAMETER SETUP LIST (UK) FOR WINDY BOY 6000

INVERTER SERIAL No. _____

CUSTOMER NAME: _____

INSTALLER NAME: _____

PARAMETER	VALUE
Upv - Start	250.000v
T - Start	180.000 s
T - Stop	3000.000 s
Usoll-Konst	600.000 v
P Limit	6000 W
I-NI TEST	0.00mA
Uac - Min	209.000 v
Uac - Max	264.000 v
AcVtgRPro	264.000 v
Vac-Tavg	80.000ms
Fac - Delta -	3 Hz
Fac - Delta +	0.5 Hz
Fac-Tavg	80.000ms
dFac - Max	0.25 Hz/s
dZac - Max	350.0 mOhm
Hardware - BFS 1.00 Version	
Software - BFR 2.550 Version	
Software - SRR 2.550 Version	
INST CODE	INSTALLER
Udc Wind Start	260.000v
Udc Wind Mid	300.000V
Udc Wind Max	320.000v
KP-Wind Reg	0.015
KI-Wind Reg	0.005
Fac-Start delta	1.000Hz
FacLimit delta	2.000Hz
T-Stop-Fan	50.000grdC
T-Start-Fan	70.000grdC
T-Max-Fan	90.000grdC
Fac-Test	0
P-Wind-Ramp	1000.000W
P-Wind-Mid	3000.000W
Betriebsart	Turbine
Memeory Function	Keine Function
*Default	GB / G83
Storage	Permanent

* Please change the **Default** setting to **GB / G83** first before proceeding to change the rest of the parameters

PROVEN 6 INSTALLATION USING TWO WINDY BOY 3000

PROVEN PARAMETER SETUP LIST (UK) FOR WINDY BOY 3000

INVERTER SERIAL No. Inverter 1: _____ Inverter 2: _____

CUSTOMER NAME: _____

INSTALLER NAME: _____

PARAMETER	VALUE	
	INVERTER 1	**INVERTER 2**
Upv - Start	290.000v	290.000v
T - Start	180.000 S	180.000 S
T - Stop	3000.000 s	3000.000 s
Usoll-Konst	600.000 v	600.000 v
P Limit	3000 W	3000 W
I-NI TEST	0.00mA	0.00mA
Uac - Min	209.000 v	209.000 v
Uac - Max	264.000 v	264.000 v
AcVtgRPro	263.000 v	263.000 v
Fac - Delta -	3 Hz	3 Hz
Fac - Delta +	0.5 Hz	0.5 Hz
dFac - Max	0.25 Hz/s	0.25 Hz/s
dZac - Max	350.0 mOhm	350.0 mOhm

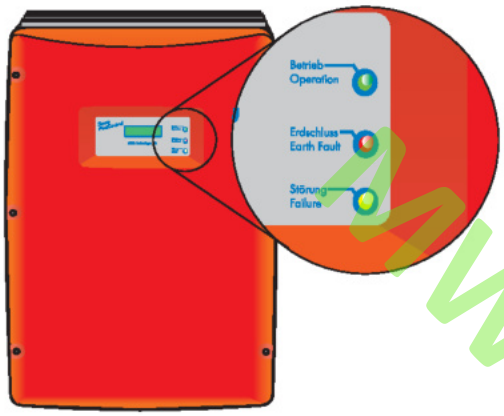
Hardware - BFS 1.00 Version
Software - BFR 2.430 Version
Software - SRR 2.440 Version

INST CODE	INSTALLER	INSTALLER
Udc Wind Start	260.000v	**280.000v**
Udc Wind Mid	300.000v	**300.000v**
Udc Wind Max	320.000v	**320.000v**
KP-Wind Reg	0.015	0.015
KI-Wind Reg	0.005	0.005
Fac-Start delta	1.000Hz	1.000Hz
FacLimit delta	2.000Hz	2.000Hz
T-Stop-Fan	50.000grdC	50.000grdC
T-Start-Fan	70.000grdC	70.000grdC
T-Max-Fan	90.000grdC	90.000grdC
Fac-Test	0	0
P-Wind-Ramp	1000.000W	1000.000W
P-Wind-Mid	1250.000W	1250.000W
Operating Mode	Turbine	Turbine
Memory Function	No Function	No Function
*Default	GB / G83	GB / G83
Storage	Permanent	Permanent

* Please change the **Default** setting to **GB / G83** first before proceeding to change the rest of the parameters

4.3 Operating Modes

The various operating modes are displayed using three light-emitting diodes (LEDs) on the housing cover of the Windy Boy. To allow the device to indicate its operating mode via the integrated LEDs, the Windy Boy must be connected on the DC side. There must be enough wind energy present, so that the Windy Boy has adequate DC voltage.



Especially in the first year of operation, the operator of the system should regularly check this display under different wind speeds.

A complete description of the possible displays can be found in section 4.3.4 "Description of the Operating Modes" (Page 17). These can be split into three categories:

4.3.1 Normal Operation

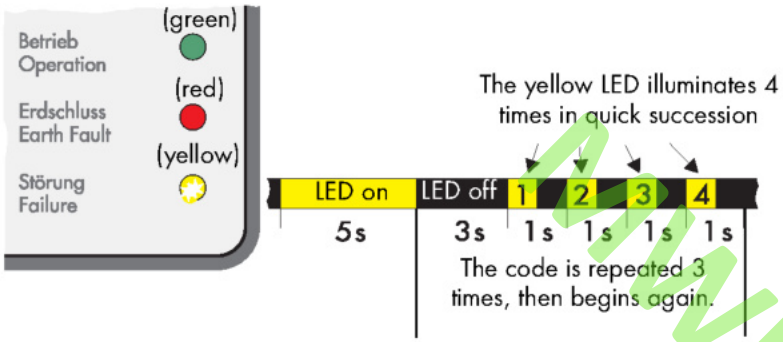
If no LED, or only the green control LED is on, or blinking, the inverter is operating normally. The simultaneous illumination of all three LEDs is also an indication of normal operation ("initialization"). All other displays are a sign of abnormal operation.

4.3.2 Critical Faulty Operation

A comprehensive safety concept has limited the number of critical conditions that can occur to one single situation:

Input voltage exceeds the permitted value!

This is indicated by the following blink code on the yellow LED:



The yellow fault LED illuminates for 5 seconds when this fault occurs, then begins displaying the blink code of: 3 seconds off, then 4 times briefly on. This code is displayed 3 times in succession. If the fault is still present, the fault display starts again from the beginning.

The presence of excessive input voltage can lead to irreparable damage! Immediately disconnect the Windy Boy's DC input.

When the Windy Boy receives an excessive DC input voltage, it automatically disconnects from the grid and ceases its power feeding activity. When the Windy Boy is in operation, you must always first disconnect the AC voltage (grid voltage) and only then should you disconnect the DC voltage from the Windy Boy!

4.3.3 Non-Critical Faulty Operation

All other display codes indicate some form of error condition, which is not usually dangerous to people or equipment, but which should nevertheless be investigated and corrected without delay.

Despite all precautions, it is possible that other errors may occur which cannot be displayed (e.g. failure of the status display). In order to recognize such errors, the operator of the system should use the explanations in section 4.3.4 "Description of the Operating Modes" (Page 17) to check the plausibility of the displayed normal operating modes.

Far more detailed diagnostics are possible using the communication options detailed in section 8 "Extensions" (Page 43) .

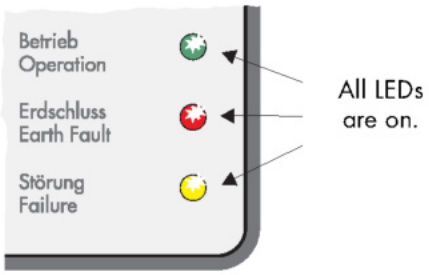
4.3.4 Description of the Operating Modes

No (or Low) Input Voltage

The Windy Boy is in the so-called Standby mode. This mode occurs when the input power at the Windy Boy is too low for feeding the grid and for satisfying the on-board power requirements.

Initialization

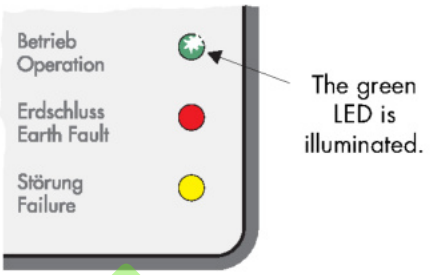
The Windy Boy's on-board computer is at present in the initialization phase. Power for the on-board power supply is present, but output power is not yet sufficient for grid feeding or for data transfer.



Working Mode

The Windy Boy has successfully passed the measurement electronics and SMA grid guard self-tests and has begun feed-in operation.

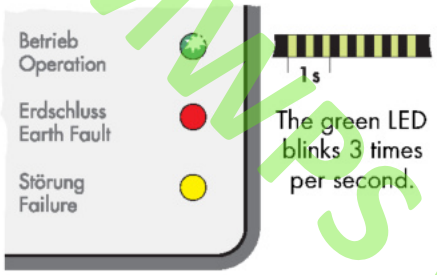
The Windy Boy is working normally and is feeding electricity into the grid. It processes the wind turbine system's DC voltage according to the programmable voltage/power curve (see section 6 "Turbine Operation" (Page 31)).



Stop

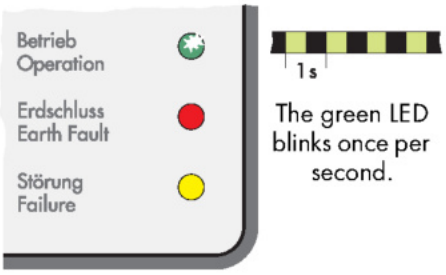
The Windy Boy is in Stop mode. Among other functions, the measurement electronics are calibrated, then the device switches to "Waiting" mode.

The "Stop" mode can also be manually set by the system operator via the Sunny Boy Control or the Sunny Data PC program. In this case, the Windy Boy remains in "Stop" mode until a new operating mode (e.g. "Turbine mode") has been set.



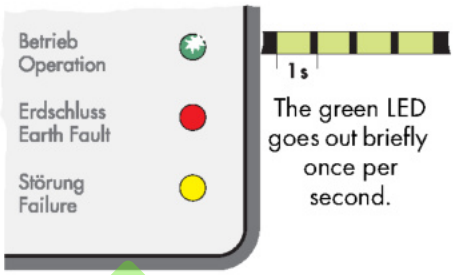
Waiting, Grid Monitoring

The Windy Boy checks if the initial conditions necessary for grid feeding are satisfied (e.g. start voltage), then begins monitoring the grid.



Derating

The temperature monitoring of the Windy Boy has reduced the output power to prevent the device from overheating. If this occurs often, this is an indication of inadequate heat dissipation or excessive input current.



- Temperature derating

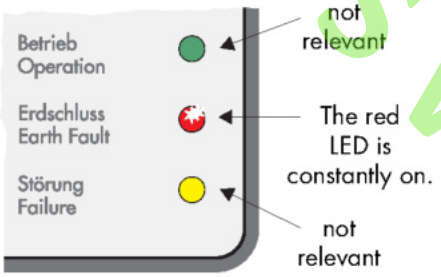
  To avoid unnecessary reductions in yield, in this case it should be checked if the Windy Boy can be mounted in a more favorable position with better ventilation.

- Current derating

  The input current on the DC side exceeds the maximum possible input current. The Windy Boy switches to the "Current Derating" mode in order to protect itself against overload. Check the system layout.

Defective Varistor or Isolation Error

The red LED on the Windy Boy is constantly on. A grounding error has occurred, or one of the thermally monitored varistors on the DC input side is defective as a result of overvoltage.

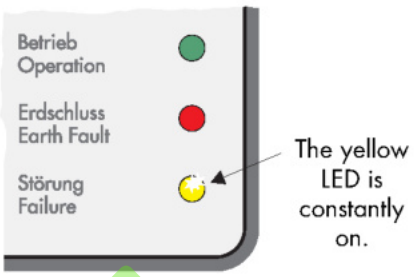


Consult a trained electrician to correct the fault using the installation manual.

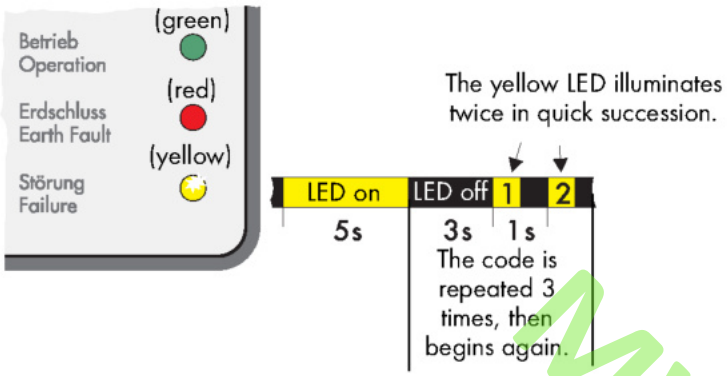
Permanent Disable

In the event of a recurring fault, the Windy Boy switches to "Permanent Disable" mode, and ceases grid feeding.

A fault may exist that cannot be resolved on-site. You can attempt to correct the error with the aid of a communication interface and the corresponding communication product (e.g. PC with Sunny Data or Sunny Boy Control). If this is unsuccessful, consult the Sunny Boy hotline (section 12 "Contact" (Page 79)) to discuss further action to solve the problem.



Grid Fault



The yellow fault LED illuminates for 5 seconds when the fault occurs, and then begins displaying the blink code of: 3 seconds off, then twice briefly on. This code is displayed 3 times in succession. If the fault is still present, the fault display starts again from the beginning.

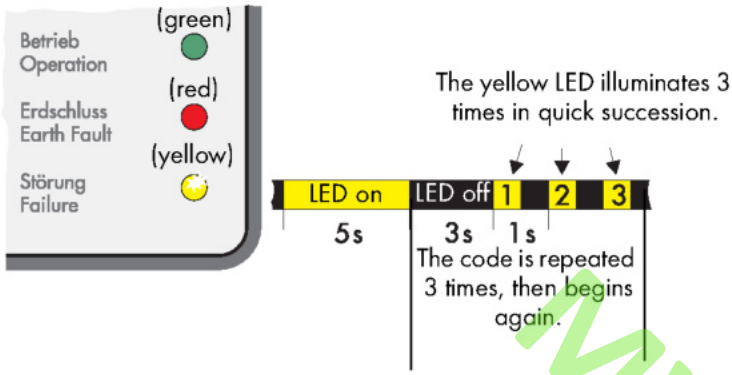
With this message, the Windy Boy indicates a grid fault, which can have the following causes:

- Grid undervoltage (U_{AC} < "Uac-Min")
- Grid overvoltage (U_{AC} > "Uac-Max")
- Grid underfrequency (f_{AC} < "Fac-Min")
- Grid overfrequency (f_{AC} > "Fac-Max")
- Grid frequency change ("dFac").

Check if a general grid dropout has occurred (check the operation of other electrical consumer devices), and check if the fuse of the Windy Boy's feed-in connection is intact.

If none of these faults can be found, then the Windy Boy's grid connection must be checked by a qualified electrician.

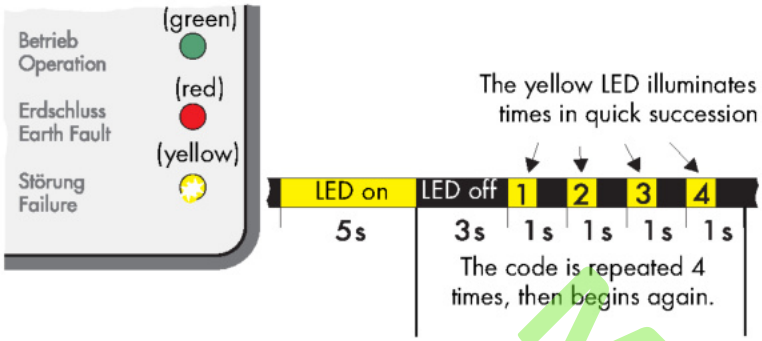
Excessive Grid Impedance



The yellow fault LED illuminates for 5 seconds when the fault occurs, and then begins displaying the blink code of: 3 seconds off, then 3 times briefly on. This code is displayed 3 times in succession. If the fault is still present, the fault display starts again from the beginning.

The Windy Boy has detected a fault relating to an unacceptable grid impedance. If the Windy Boy frequently deactivates and displays this error during grid monitoring, the cause can be an excessive grid impedance. A qualified electrician can usually assist with this problem by increasing the cross-section of the grid connection cable. Other measures can be taken to correct this fault, but they require the explicit agreement and cooperation of the grid operator.

Excessive Input Voltage

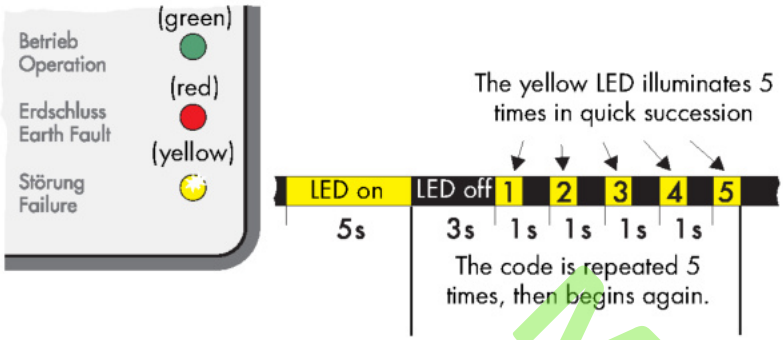


The yellow fault LED illuminates for 5 seconds when the fault occurs, then begins displaying the blink code of: 3 seconds off, then 4 times briefly on. This code is displayed 3 times in succession. If the fault is still present, the fault display starts again from the beginning.

Immediately disconnect the Windy Boy's DC input. The presence of excessive input voltage can lead to irreparable damage! Make sure that the input voltage never exceeds 600 V.

When the Windy Boy receives an excessive DC input voltage, it automatically disconnects from the grid and ceases its power feeding activity. When the Windy Boy is in operation, you must always first disconnect the AC voltage (grid voltage) and only then should you disconnect the DC voltage from the Windy Boy!

Device Fault

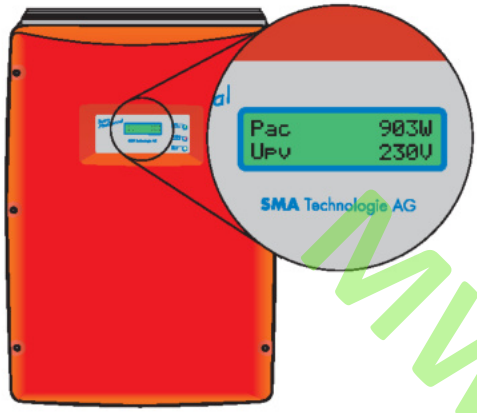


The yellow fault LED illuminates for 5 seconds when the fault occurs, then begins displaying the blink code of: 3 seconds off, then 5 times briefly on. This code is displayed 3 times in succession. If the fault is still present, the fault display starts again from the beginning.

If the device fault leads to a major impairment of normal operation, the Windy Boy and the entire system installation should be checked by a qualified electrician.

4.4 Information on the Display

Since 2006, the Windy Boy has been equipped with an LCD display in the housing cover as standard.



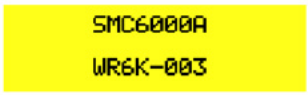
Activating the Display Illumination

The background illumination is switched on by tapping on the housing cover. Tapping again switches the display to the next message.

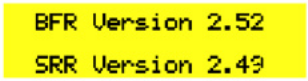
After 2 minutes, the illumination switches off automatically.

Display Messages in the Startup Phase

The following messages are displayed during the Windy Boy's startup phase. Since the Windy Boy is identical to the Sunny Boy (apart from the operating mode), the display shows "Sunny Boy".



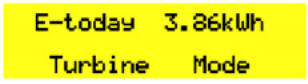
After 6 seconds, the firmware versions of the operation control unit (BFR) and the current control unit (SRR) are displayed.



Display Messages During Operation

The display shows the Windy Boy's most important operating data in a continuous cycle. The following three screen images serve to clarify the display messages. Each message is displayed for 5 seconds. Then the cycle begins again.

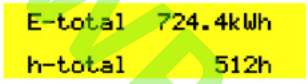
The energy generated today and the current operating mode are displayed first.



The amount of energy shown under "E-today" does not necessarily reflect the amount of energy produced over the last 24 hours. This is rather the energy produced by the Windy Boy since the last deactivation / activation.

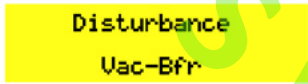
Subsequently, the present feed-in power and the output voltage are displayed.

This is then followed by the total energy produced so far and the operational hours of the device.



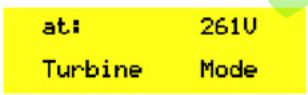
Fault Displays

If an operational fault occurs, the display immediately switches to "Disturbance" and the background illumination is switched on.



The cause of the fault is displayed for 5 seconds in the second line of the display.

If a measured value is responsible for the fault condition, then the value measured at the time of the fault is displayed. If another measurement is possible, the present value is displayed in the second line.



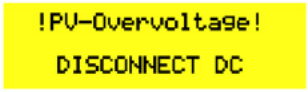
After another 5 seconds, normal operating data is again displayed.

If the fault is still present, the fault display starts again from the beginning. An overview of the status and error messages can be found in section 10.2 "Error Messages" (Page 68) of this document.

"Error ROM" indicates that the Windy Boy has detected an error in the EEPROM firmware. Contact SMA to have the error corrected.

Special Display Message Upon Excessive DC Input Voltage

If an excessive DC input voltage is present at the Windy Boy, this is indicated by rapid blinking of the background illumination and the message shown here to the right.



Immediately disconnect the Windy Boy's DC input. The presence of excessive input voltage can lead to irreparable damage! Make sure that the input voltage never exceeds 600 V.

When the Windy Boy receives an excessive DC input voltage, it automatically disconnects from the grid and ceases its power feeding activity. When the Windy Boy is in operation, you must always first disconnect the AC voltage (grid voltage) and only then should you disconnect the DC voltage from the Windy Boy.

Before resuming operation, the input voltage must be checked before reconnecting the DC voltage to the Windy Boy! Since the Windy Boy is identical to the Sunny Boy (apart from the operating mode), the display shows "PV" (photovoltaic) as the input source.

Mechanical Installation

3.0 Mechanical Installation

3.1 Tools Required

Number	Description	Used For
2	10 mm Spanners (1 open ended)	Slip Rings
2	13 mm Spanners (1 open ended)	Blade and Spring Fixings
2	17 mm Spanners (1 open ended)	Blade fixing bolts Spring U - bracket fixings
2	19 mm Spanners (1 open ended)	Lower Yaw Bearing
2	24 mm Spanners (1 open ended)	Upper Yaw Bearing (plus main shaft bearing at generator end – normally factory tightened)
1	3 mm Allen Key	Slip Rings grub screw
1	5 mm Allen Key	Yaw Bearing grub screw
1	Pair of Wire Snips	Trimming cover cable ties
1	36mm Spanner for TM900 or 46mm Spanner for TM1500 (e.g. 36mm socket on ¾" drive ratchet with 1m scaffold tube or similar for extension. 4" to 6" socket extension sometimes useful)	TM900 M24 Tower Bolts TM1500 M30 Tower Bolts (connecting tower onto base plate)
1	Tube of glazing silicon & gun	Cover Sealant
1	Loctite Studlock (A118 or similar)	**All Fixings – must be used on all stainless steel nuts and bolts**
1 Set	Pliers, Wirestrippers, large crimping tool, assorted crimp lugs etc	Wiring
1	Hacksaw	Occasionally Stainless steel nuts lock during tightening. Hacksaw is sometimes the last resort! May also be used to trim foundation j-bolts if required
1	46mm Spanner (e.g. 46mm socket on ¾ drive ratchet with 1m scaffold tube or similar for extension. 4" to 6" socket extension sometimes useful)	M30 J- bolt nuts (connecting base plate to concrete foundation)
1	Flat file	Removing any galvanising drips to allow tower fitting with yaw bearing

3.2 Tower Assembly

The Proven TM900 tower is a single piece tower whereas the TM1500 is in three sections. In certain instances (e.g. an easily accessible site with a suitable lifting device) the TM1500 can be supplied in one piece.

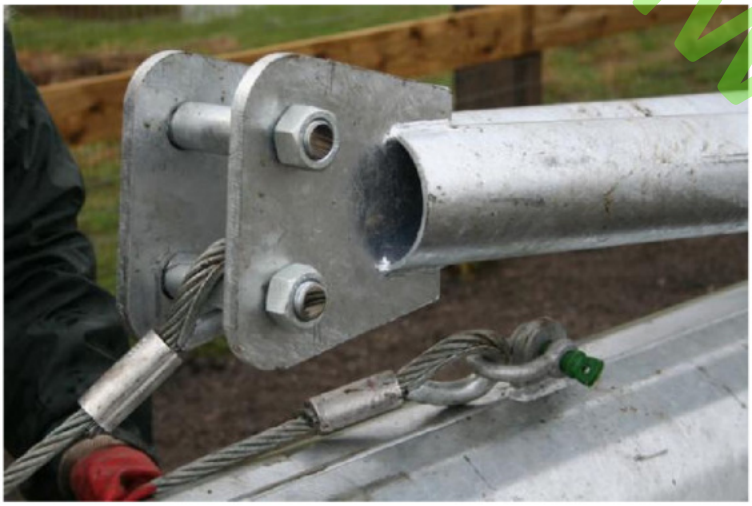
Where the tower is supplied in one piece please follow the installation procedure below and for all others please refer to **Appendix B** (tower assembly and erection procedure) for procedure.

TM1500 Base Section

TM1500 Middle Section

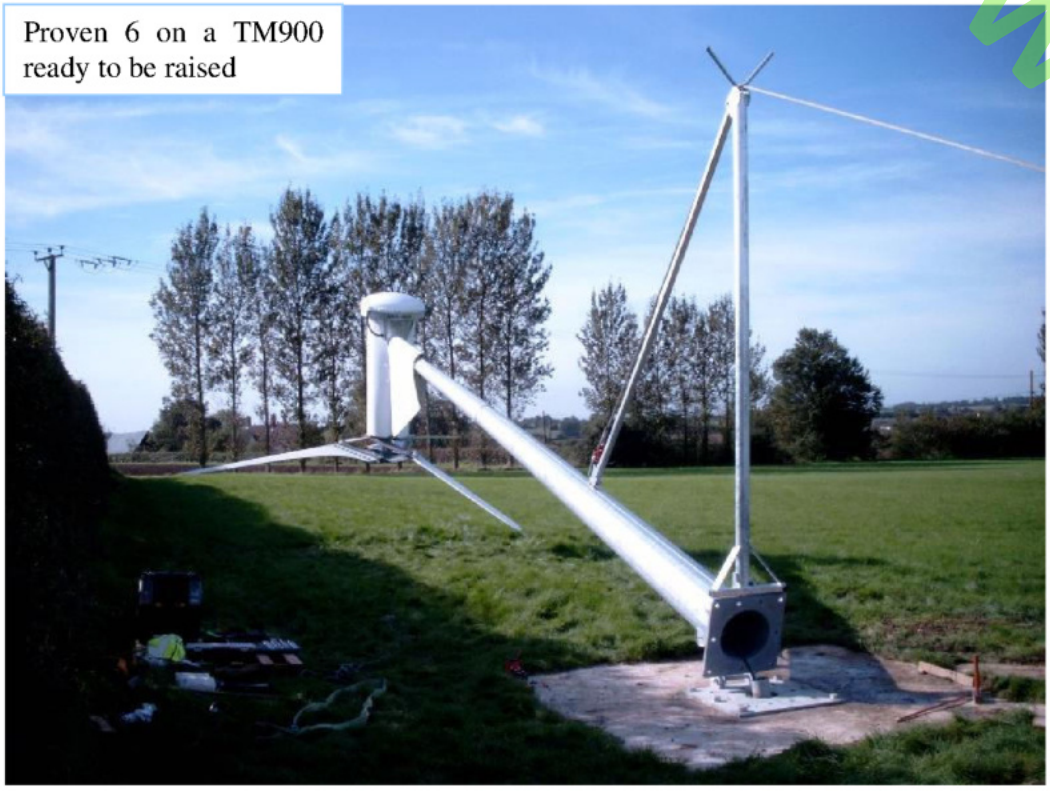
TM1500 Top Section

Gin Poles Being Positioned



Proven 6 on a TM1500 ready to be raised

Proven 6 on a TM900 ready to be raised



3.3 Fitting the Turbine Head to the Tower Top

3.3.1 Procedure

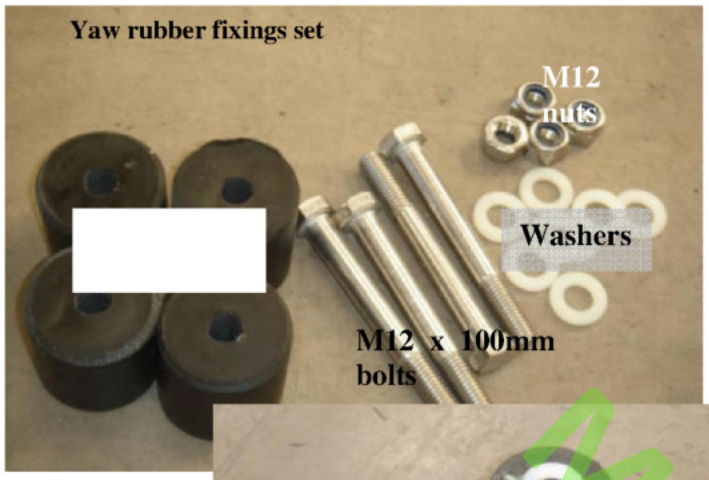
- Prepare tower for fitting with the head

- Fit yaw bearing on to spigot ensuring grease nipple is accessible and push turbine head fully home. If slip ring brushes are fitted then be careful not to damage brushes when pushing head fully home.

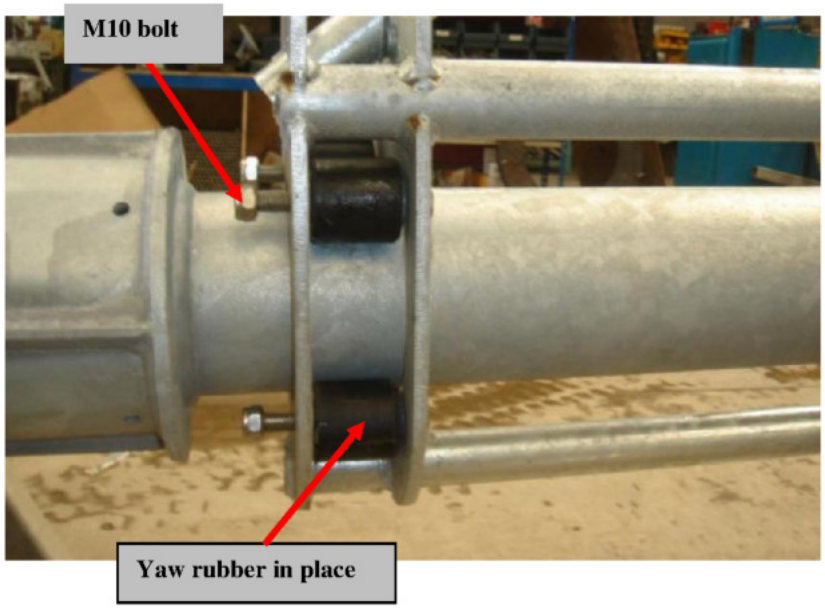
- The yaw bearing fixing bolts (M16) can now be tightened. The turbine head can now rotate around the tower. Withdraw the head assembly back off the tower approximately 50mm, Spread some thread locking compound (loctite A118) onto the spigot and push head fully home. Tighten bearing grub screw using a 5mm allen key. The thread lock compound ensures a secure fit between the spigot and the bearing. It is also recommended to glue in the grub screws to stop them vibrating loose.

M16 bolt being tightened with a wrench

- Prepare yaw rubbers and bolts for fixing by greasing the bolts and rubber ends



- Fit yaw rubbers. Fit bolt through yaw frame hole as shown below, and guide it



through the rubber and nylon washer and through the lower frame hole.

- Tighten the yaw rubber bolts using a 19mm ratchet and 19mm spanner. Do not over tighten the rubbers so that they can rotate

- Check everything is tight and that the turbine will freely rotate within its yaw axis.
- Finally spin the rotor by hand to check that nothing rubs. If the turbine has been roughly handled then the domed generator cover can get pushed against the magnet plates. If this is the case gently tap the cover back into position and reseal if necessary with silicone.

Important

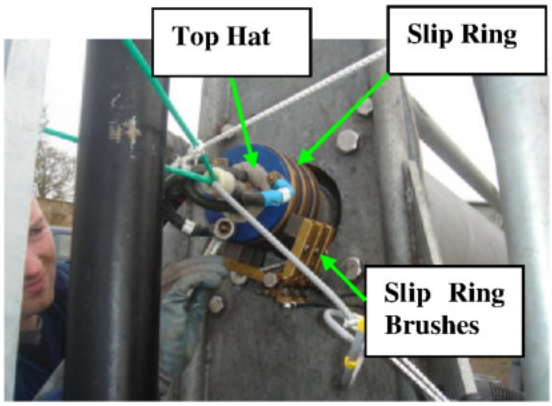
Mechanical and electrical installations will be required in the nacelle of the turbine.
Also if the turbine head is above normal working heights, provision will have to be made for scaffolding or other access means.

3.4 Slip Ring Assembly

3.4.1 Description

A slip ring is an electromechanical device that allows continuous electrical connection and transmission of power from a stationary to a rotating structure. Additionally, the slip ring helps prevent the down cable and brake rope from twisting. The slip ring assembly consists of:

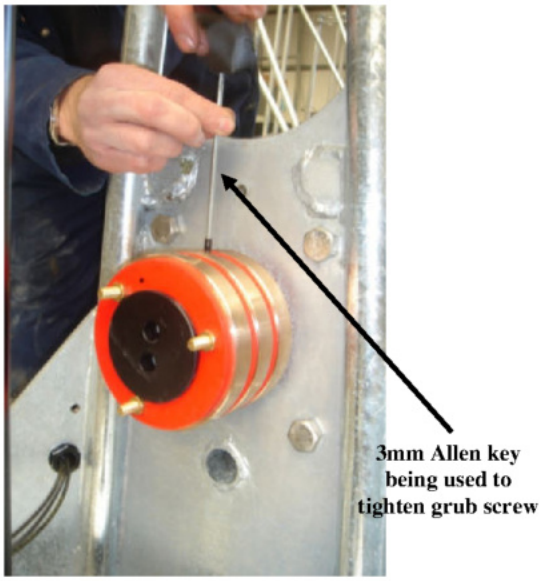
1. Slip ring (3-ring) including grub screws
2. Mount stand for slip ring brushes
3. Slip ring brushes for each ring



3.4.2 Procedure

- Smoothen the tower spigot surface to be fitted with the slip ring with a sand paper.

- If cable is fitted at this stage then feed cable through the slip ring and top hat. If not the fit slip ring onto spigot, fit top hat into the end of slip ring so that it butts up against the end of the tower top This is the position the slip ring should be secured in. Slide back the slip ring and top hat and apply loctite to the spigot and then re-fit and secure using the grub screws. Use a 3mm allen key to fix grub screws in place - use A118 on grub screws.

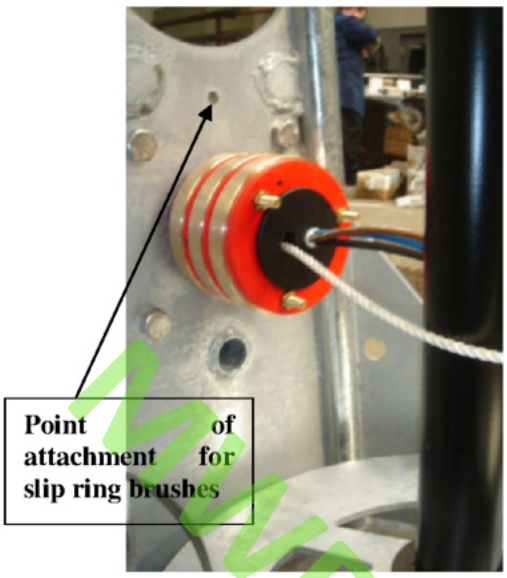


Slip Ring Connections:

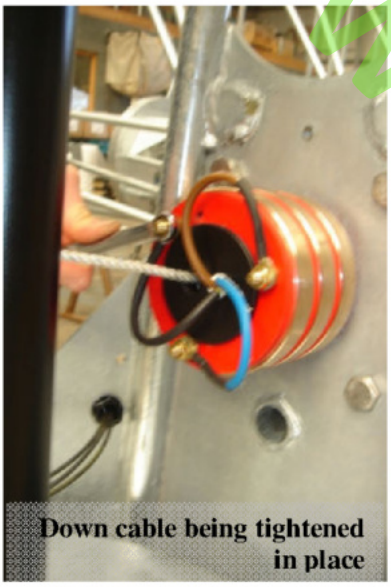
This assumes brake rope and cable are in position and are fitted through top hat assembly

.

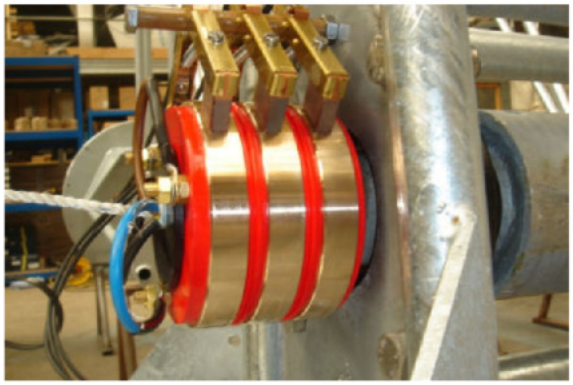
- Using two 17mm spanners attach the slip ring brushes to the turbine frame. Again be careful not to over tighten as the tube can break.



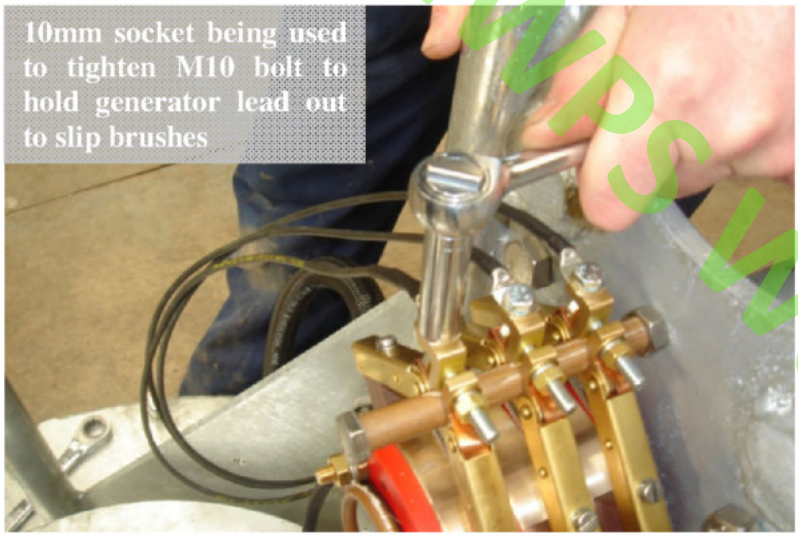
- Loosen the 3 stud nuts on top of the slip ring unit and connect the down cable ends at the top hat to the 3 studs. Tighten the stud nuts with a 13mm spanner. Do not over tighten as you may shear the copper stud. Vibration washers are included to ensure a secure fit. Note any cable can be connected to any stud.



- With a 10mm socket loosen the bolts on the brushes till the brushes can be moved freely. Position the brushes in the middle of the rings. Adjust for good contact and then tighten bolts.



- Connect the generator lead out wires to the top of the brushes and tighten using a 10mm socket.

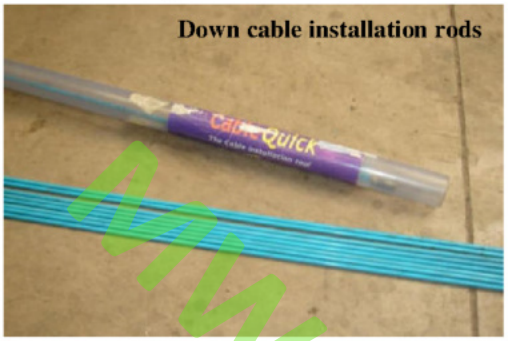


10mm socket being used to tighten M10 bolt to hold generator lead out to slip brushes

3.5 Preparing the Cable Termination at the Turbine Head End

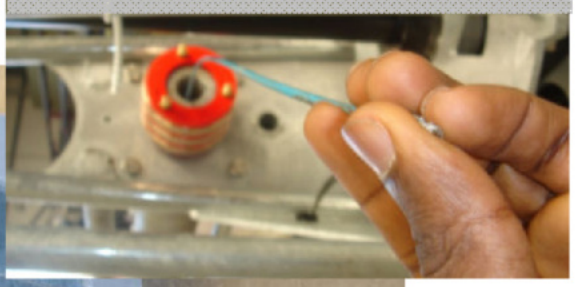
3.5.1 Procedure

- Assemble down cable installation rods (not supplied) so they are long enough to match tower height. Alternatively a draw string or other suitable methods can be used to pull cable down from the top of tower to the bottom.



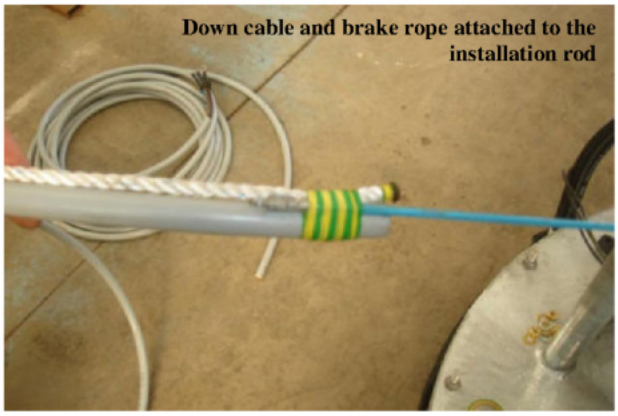
Down cable installation rods

- Feed the assembled installation rods (now a long rod) through the slip ring at the tower top to the bottom of the tower.


Down cable installation rod being fed through the slip ring at the tower top to the bottom of tower

Down cable and brake rope at the bottom of tower

- Using an adhesive tape, attach the brake rope and down cable to the assembled installation rod. Pull the end of the rod at the bottom of the tower till other end with the attached rope appears. Now detach the rod from the down cable and brake rope.



Down cable and brake rope attached to the installation rod

- Feed the end of the down cable at the top of the tower through one hole of the top hat and similarly feed the remaining hole with the brake rope.

Down cable ends (generator lead out) fitted through top hat. Brake rope goes into the other hole

- Now fit the top hat to the slip ring.

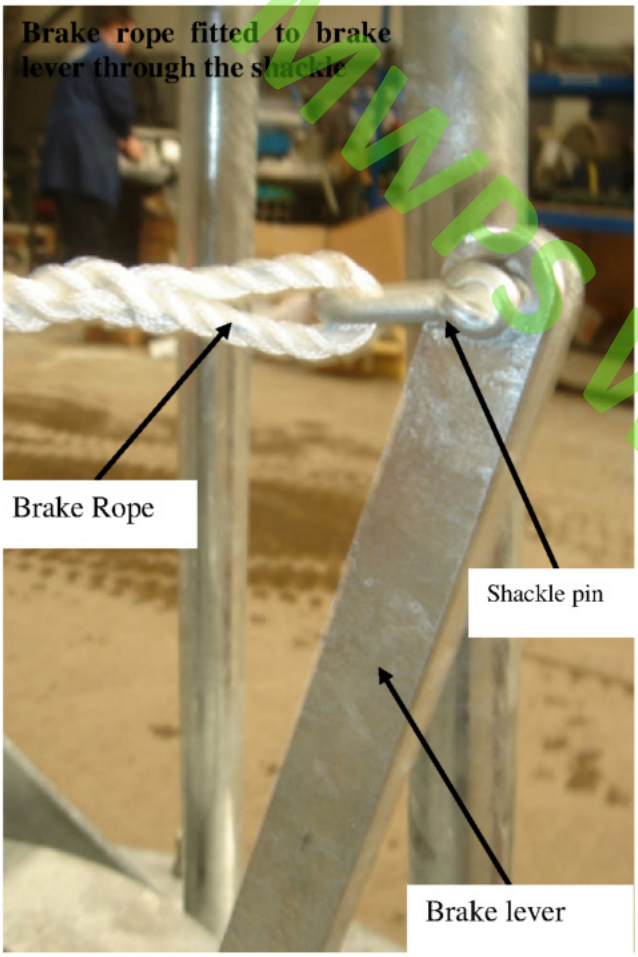
3.6 Brake Rope Installations

The mechanical brake assembly is made up of the following components located in the nacelle of the turbine:

1. Brake disc
2. Brake pads
3. Nacelle brake levers, which are already factor fitted and connected
4. The first brake rope runs from nacelle brake lever to the pulley just below the brake guide.

3.6.1 Procedure

- Attach the end of the brake rope that comes out through the top hat to the shackle of the brake lever. Note Shackle pin is removable.



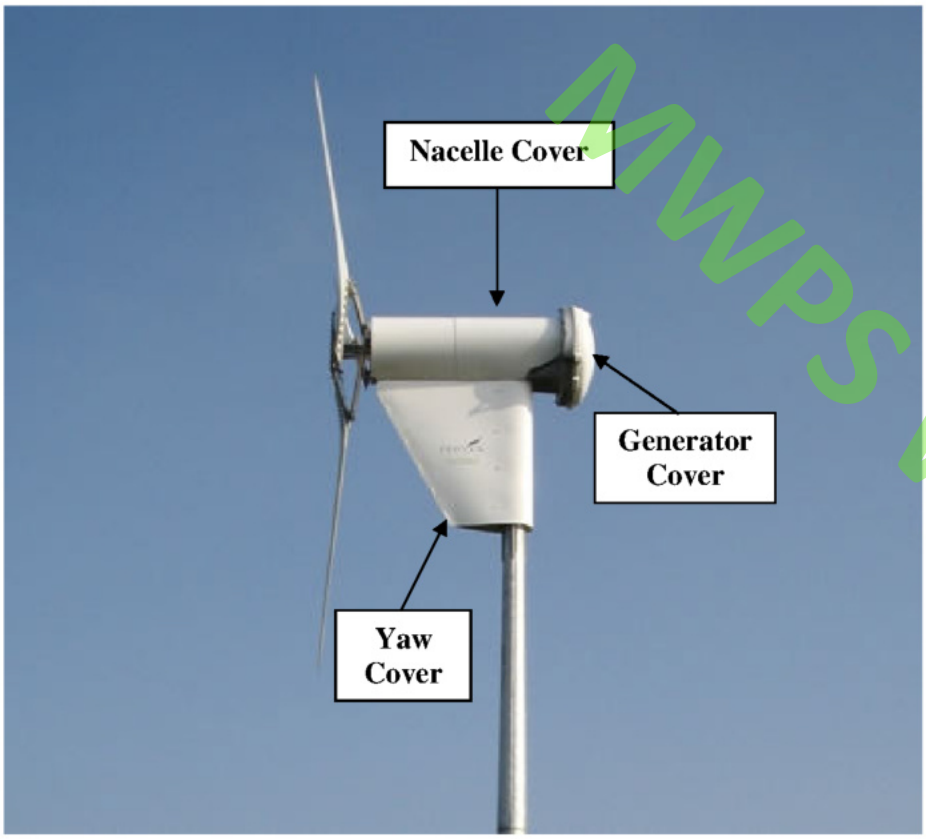
- Tie the loose brake rope from the generator shaft with a rope to the turbine frame.

3.7 Fitting the Covers

The turbine is supplied with the following covers:

1. Generator cover
2. Yaw cover
3. Nacelle cover (also called the rotor shaft cover - supplied in 2 pieces)

The covers are made from black (or white) U.V. stabilised polypropylene plastic. They are fitted to the wind turbine frame using cable ties. The two – piece nacelle covers are stitched together after fitting to the turbine frame individually.



The yaw cover is fitted **first!**

NB. Proven Energy Ltd does not recommend painting of the covers as the paint would peel off after a short while.

3.7.1 Fitting the Generator Cover

The generator cover is secured over the electrical generator by means of an SS "Jubilee clip". The generator is supplied with the cover already fitted.

3.7.2 Fitting the Yaw Cover

Procedure

STEP 1: Offer up yaw cover to the frame and attach using the cable ties. Feed cable tie from front through cover around the steel bar and back through the other hole, secure tie but **do not** fully tighten until all ties have been fitted.

STEP 2: Fold the cover around the frame under the generator end and secure the cover to the frame as in step 1.

Yaw cover being positioned

STEP 3: Finally tighten all ties and trim.

Please note the way the cable ties are tied.

3.7.3 Fitting the Nacelle Cover

Procedure

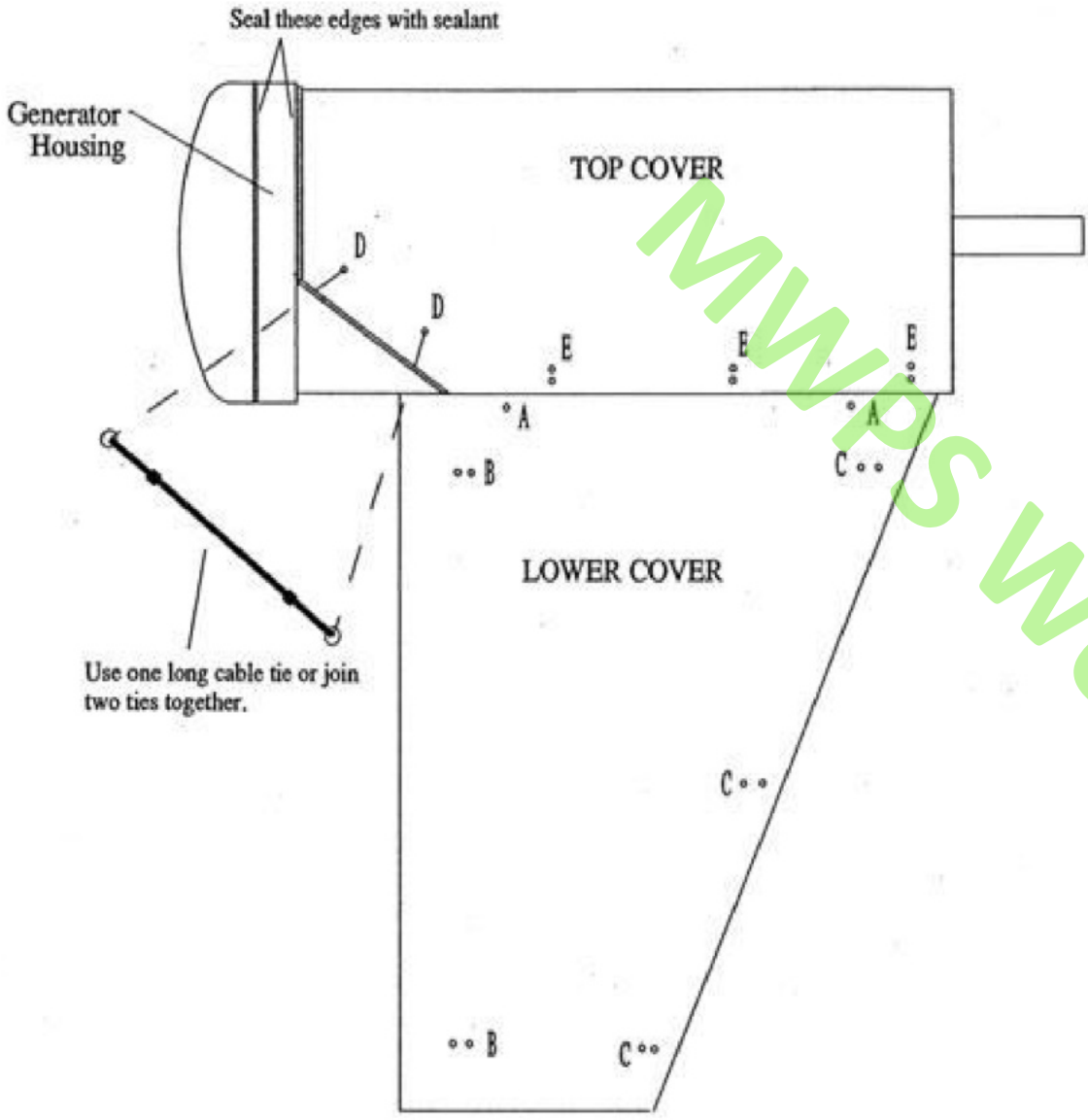
STEP 1: Offer up the first nacelle cover to the frame, attach using the cable ties. Feed cable ties through cover then through plate and back through cover and secure. This joins cover to frame. It may be necessary to join cable ties together to get the required length.

STEP 2: Fold the cover over and around the frame and secure as in step 1.

STEP 3: Offer up second nacelle cover to the frame. Fold around the frame and fit this cover under the edge of the first nacelle cover as shown. Loosely stitch the cover parts together using cable ties. When stitching these parts together be sure to go around the frame as well.

STEP 4: Fit ties through the rest of the cover holes and around frame parts. Finally tighten all cable ties and trim.

Please note the way the cable ties are tied.


Seal these edges with sealant
Generator Housing
TOP COVER
D
D
E
E
E
A
A
B
C
LOWER COVER
Use one long cable tie or join two ties together.
C
B
C

3.8 Blades Assembly

Caution!
Treat the blades with exceptional care – especially the leading and trailing edges of the airfoil.

3.8.1 Blade Description

The blades are made of the following parts

1. Airfoil – Glass Thermoplastic
2. Zebedee hinge at blade root – polyurethane
3. Root of blade – Galvanised steel

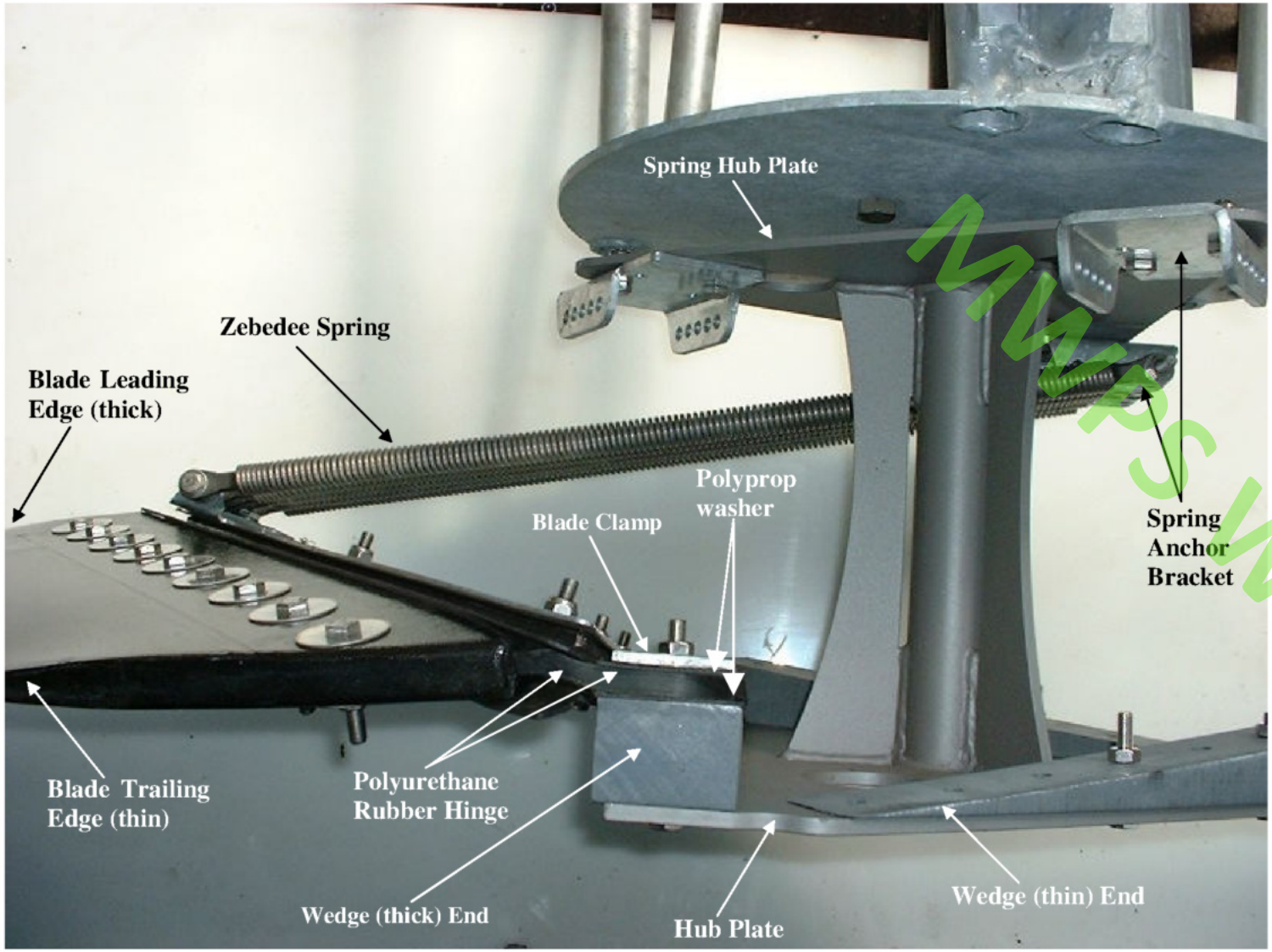
These three parts are supplied already assembled.

> ***Information***
>
> The blades are bolted to the hub plate by means of:
> 1. SS bolts provided
> 2. Galvanised steel clamp plates provided
> 3. Polypropylene clamp washer provided.

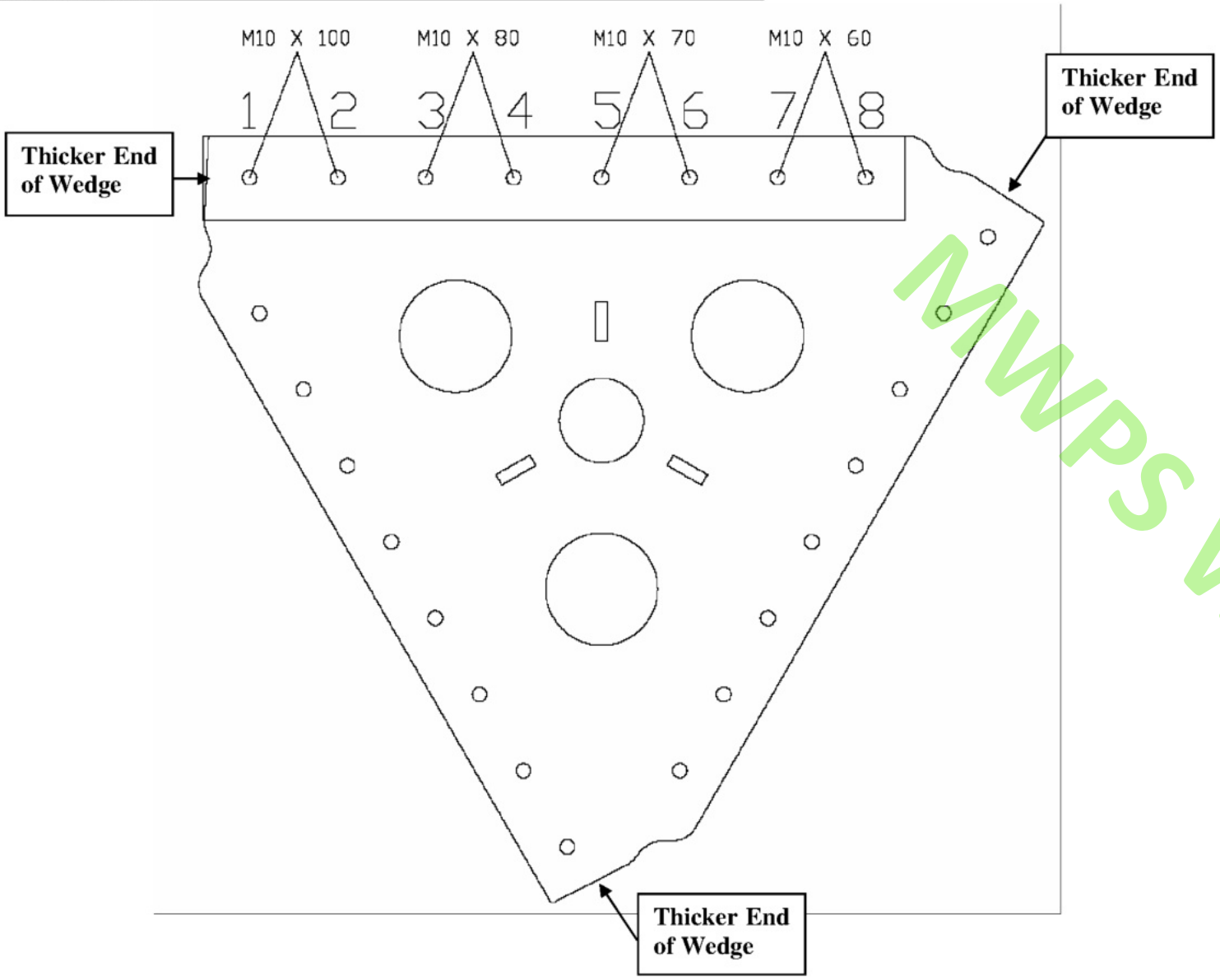
3.8.2 Fitting the Blades

Procedure

- Put polyprop (plastic) washer on top of wedge
- Place PU (rubber) hinge of blade on top of washer
- Place further washer on top with metal clamp plate as final layer
- Secure blade using M10 bolts and lock nuts provided. It is good practice to use Loctite Threadlock (A118 or similar) to lubricate **and** secure fixings against vibration. Use only a **small** amount on each bolt.
- Attach Zebedee springs to the blade bracket and spring anchor bracket.
- It is **very** important that the M10 fixing bolt running through the spring ends is not fully tightened. The spring ends should be allowed to freely rotate during normal operation. However, there should be no lateral play of the spring ends within the spring bracket.
- Check all fasteners are tight and repeat for the other two blades.


Spring Hub Plate
Zebedee Spring
Blade Leading Edge (thick)
Polyprop washer
Blade Clamp
Spring Anchor Bracket
Blade Trailing Edge (thin)
Polyurethane Rubber Hinge
Wedge (thick) End
Hub Plate
Wedge (thin) End


Thicker end of wedge faces the same way as the trailing (thinner) edge of the blade.


M10 X 100
M10 X 80
M10 X 70
M10 X 60
1
2
3
4
5
6
7
8
Thicker End of Wedge
Thicker End of Wedge
Thicker End of Wedge

Caution!

Ensure that the blades and wedges are put the right way or else the turbine would overspeed resulting in high voltage being transferred to the controller and inverter.

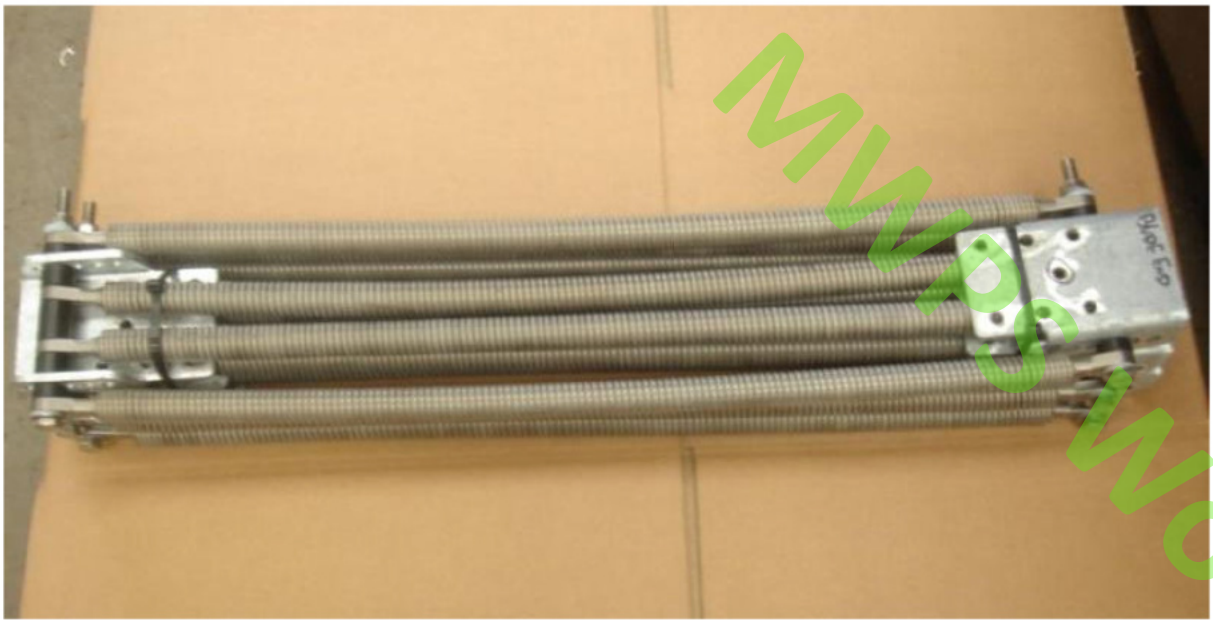
3.9 Zebedee Spring Assembly

3.9.1 Description

The Zebedee spring assembly consists of the following **per blade:**

1. Zebedee spring assembly made up of 4 individual springs.
2. U-bracket for connection to spring hub plate.
3. U-bracket for connection to blade root.

These three items are normally supplied already fitted together.



Fitting the Zebedee Spring Assembly

3.9.2 Procedure

NB: U – bracket for the blade end and rotor end are marked on the U –brackets. U – brackets are bolted via the holes circled on them.

- Squirt locktite on 2off M10 x 60 bolts
- Bolt the U-bracket (marked rotor end) using the two M10 x 60 bolts to the hub plate
- Squirt locktite on 1off M10 x 70 bolt
- Bolt the U-bracket (marked blade end) using the M10 x 70 bolts to the blade root (NB: raise the blade at the tip end slightly to help insert bolt through the blade root)
- Repeat the steps above for the remaining two sets of springs

U – Bracket bolted
to blade root

3.10 Raising the Turbine

Procedure

- Check hinge pin is in position and split pins at each end.
- Fit gin pole to bottom of pole to bottom of pole and strut to mid pole bracket – check nuts are tight on bolts.
- Hook Tirfor wire rope to mid pole bracket. Hook Tirfor to winch anchor, feed rope through Tirfor as per Tirfor instructions.
- Check that cables will not be trapped under pole base.
- Apply wind turbine parking brake
- Pull wind turbine up slowly with Tirfor.
- When upright keep tension on rope until all base bolts are in and tight. When base bolts are tight, release rope. Dismantle tackle and gin pole.
- If putting into service, release wind turbine and check rotation is OK, if breezy

Caution!
Clear lifting area of all non - essential personnel. Do not allow anyone to be in the vicinity of the wind turbine whilst raising and lowering.

3.11 Lowering the Turbine

Procedure

- Apply wind turbine parking brake. Place trestle or support to offer support lowered to pole.
- Fit gin pole and rope tackle as for raising. Check all shackles, bolts and fittings are secure – check again before lowering.
- Take up slack in Tirfor.
- Put handle in lowering position. Make sure hinge pin and its splits are in place.
- Take out base fixing bolts
- Pay out a little rope and lift end of gin pole to tilt wind turbine over balance point until strain comes on Tirfor.
- Now lower wind turbine gradually with Tirfor.

3.12 Testing with a Third Party Mast

A cautious approach should be taken to testing the turbine in operation with a new design of third party mast.

It is not fully known initially if the mast is suitable for the dynamic operation (rpm range 0-200 rpm) of the turbine.

An engineer should maintain a close view of the turbine under operation in a wide range of wind speeds and rpms. This may last some days depending on the wind conditions!

Important

If serious wobble or vibration occurs then the turbine brake should be applied immediately! Report the any problem during testing to Proven and mast manufacturer.

3.13 Winch Set Up

Specification

Recommended Tirfor Hand Winches

Model T532

- Safe working load for lifting 800kg with a 5:1 safety factor.
- Weight – 24kg
- 20m wire rope
  - Weight – 26.6kg
  - Diameter - 16.3mm
  - Breaking strain – 16000kg
- Telescopic Operating handle
  - Weight – 2.3kg
  - Length (closed/extended) – 65/115cm

Model T516

- Safe working load for lifting 1600kg with a 5:1 safety factor.
- Weight – 13.5kg
- 20m wire rope
  - Weight – 13kg
  - Diameter 11.5mm
  - Breaking strain – 8000kg

NB: Refer to appendix for detailed instructions on winch usage and safety information

4.0 Wind Turbine Maintenance

Your Proven 6, like all Proven Energy turbine models, requires minimal maintenance. We recommend regular visual inspection to spot any unusual occurrence.

We however believe that if the following maintenance activities are carried out at the recommended times then very little could go wrong.

4.1 Annual Maintenance

- Lower wind turbine as described previously
- Grease (Lithium EP – 2 multi purpose grease recommended) main rotor bearings and yaw bearing housing
- Check slip-ring assembly with emery cloth and grease as necessary
- Check flange bolts, tower base bolts, base box bolts for tightness
- Check all power and signal connections and wires
- Listen for any abnormal noises or excessive vibrations as a check for possible loose fittings or components
- Check brake pad thickness is more than 2mm and replace if worn beyond 2mm
- Check brake operation before raising wind turbine
- Check for general wear and tear and replace any worn parts
- Pay particular attention to the blades, especially the blade root. A damaged or cracked blade should be repaired or replaced immediately.

Caution!
Any damaged or cracked blade should be repaired or replaced immediately.

4.2 Maintenance Check List

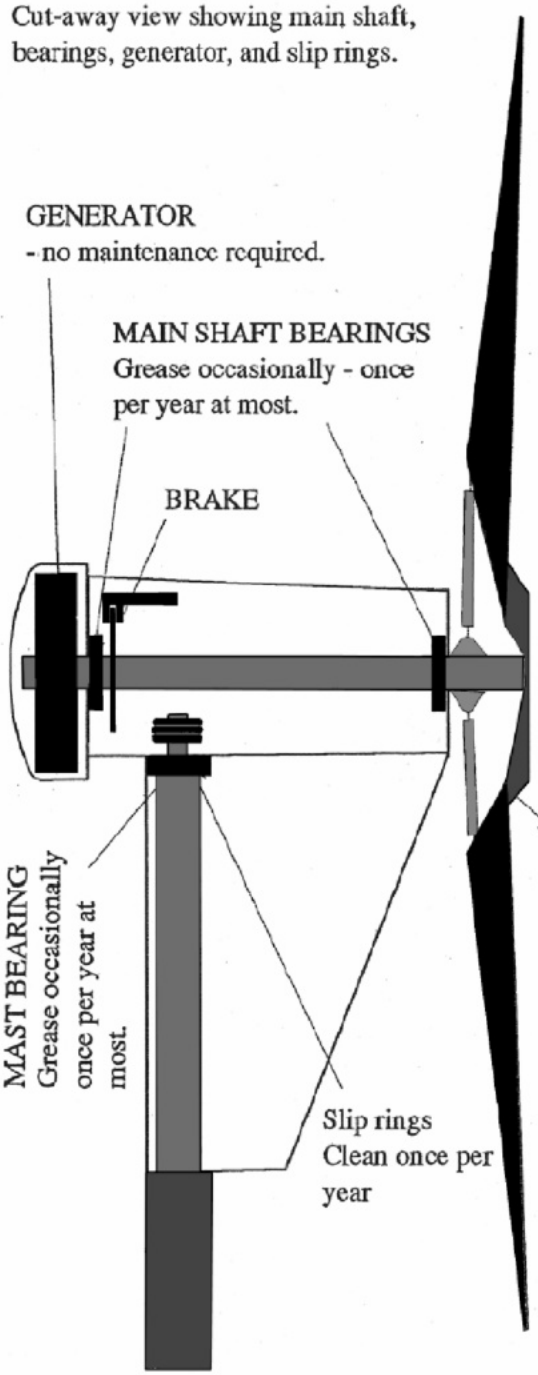
KEY:

- X = Check
- C = Clean
- G = Grease
- R = Replace if need be
- A = Adjust if need be

TOWER / BASE			
1 GENERAL CONDITION	X		
2 FOUNDATIONS	X		
3 NUT / BOLT TIGHTNESS	X	A	
4 S/S SHIM	X	A	
5 WELDS / FILLETS	X		
6 HINGE BOLTS	X		
7 GIN POLE ASSEMBLY	X		
SLIP RING ASSEMBLY			
8 SLIP RING CONNECTIONS	X		
9 SLIP RING BODY	X	C	
10 SLIP RING BRUSHES	X	A	R
11 TOPHAT	X		
12 NUT / BOLT TIGHTNESS	X	A	
13 TOPHAT	X		
BLADES & SPRINGS			
14 BLADE CONDITION	X		
15 P.U. HINGES	X		
16 BLADE FIXINGS	X		
17 SPRING FIXINGS	X		
18 SPRING CONDITION	X		
19 NUT / BOLT TIGHTNESS	X	A	
20 WEDGES	X		
21 WASHERS / CLAMPS	X		
BRAKE SYSTEM			
22 BRAKE ASSEMBLY PARTS	X		
23 BRAKE OPERATION	X		
24 BRAKE PADS	X	R	
25 SHACKLE / ELASTIC	X		
26 BRAKE ROPE CONDITION	X	R	
27 BRAKE LEVERS	X		
ELECTRICAL SYSTEM			
28 CONTROLLER OPERATION	X		
29 V & I METER OPERATION	X		
30 CABLE CONNECTIONS	X	A	
31 CONDITION OF WIRING AND ph – ph VOLTAGES	X		
32 INVERTER CONNECTIONS	X		
COVERS & OTHER CHECKS			
33 GENERATOR COVER CONDITION	X		
34 YAW COVER CONDITION	X		
35 NACELLE COVER CONDITION	X		
36 CABLE TIES	X	R	

Service Schematic

Cut-away view showing main shaft, bearings, generator, and slip rings.



Maintenance Schedule

Once per year:
Grease the three bearings,
Clean slip rings
Check Brake pads
Check nuts and bolts.
Check springs

Operation

No action is required during normal running
the system is self regulating and automatic with passive fail-safe speed and power control.

Proven Patent Passive Blade control system

4.3 Spare Parts List

PROVEN ENERGY

RECOMMENDED SPARE PARTS LIST

PROVEN 6 WIND TURBINE GENERATOR

Item	Part Description	Manufacturer (M)	Part No. (M)	UOM	Unit Price GBP	Lead Time (weeks)
001	Set (3) of Glass Thermoplastic Composite Blades with PU & Fixings	Proven Energy Ltd	BL6001	SET		4
002	Set (4) of Yaw Rubbers	Proven Energy Ltd	YRO6000	SET		2
003	Set (3) of Zebedee Springs	Proven Energy Ltd	ZBT6001	SET		2
004	Set (2) of Brake Pads	Proven Energy Ltd	BRK6001	SET		2
005	Sliprings and Brushes	NSK - RHP Bearings Ltd	SR6001	PC		4

Remarks:

Rev No: 01

Ex Works Stewarton UK

Date: 28/11/06

Signature:

Focal Point Supplier

Name: Mr. David Watson
Address: Wardhead Park, Stewarton, KA3 5LH
Country: United Kingdom
Tel/Fax: +441560485570/+441560485580
Email: info@provenenergy.com

Description: Wind Turbine Generator

Supplier: Proven Energy Ltd

Project:
Client:
Purchase Order No:

5.0 Trouble Shooting

Problem	Possible Cause(s)	Diagnosis	Remedy
Louder than quoted noise level	- Loose fittings or components	- Check to see if all fittings and components are tightly fitted. - Check if any bolt needs grease (especially yaw rubber bolts)	- Tighten loose fittings or components - Grease bolts
Turbine fails to turn in good wind	- Shorted cables - Shorted diodes - Failed bearings - Brake rope on lever	- Check connections - Check brake lever	- Repair short circuit - Replace faulty diodes - Replace bearings - Remove brake rope from lever
Turbine turns slowly in good wind	- Partial short in cables - Diode short - Brake rope on lever	- Check connections	- Repair short circuit - Replace diode
Low output	-Low wind speeds -Obstructions around turbine -High power usage - Inverter setting not right	- Measure wind speed - Check siting of turbine - Check power usage - Check inverter settings	- Site turbine in a better location or height - Economise power use - Program inverters with correct settings from parameter list
Turbine vibrates excessively	-Blades incorrectly fitted or out of balance -Yaw rubber worn	- Check blade fittings - Check yaw rubbers	- Fix blade properly and balanced - Replace yaw rubbers
No output though turbine turns at high speed	-Cables disconnected -Battery fuse blown -Controller ammeter open circuit	- Check connections	- Fix cables - Replace fuse - Replace meter

Appendices

Appendix A: Weights and Dimensions

Appendix B: TM1500 Tower Assembly and Erection Procedures

Appendix C: Lifting Equipment Instruction Sheets

Appendix D: Warranty Document

Appendix A

Weights and Dimensions

Appendix A: Weights and Dimensions

Item	QTY	Dimension	Weight
WT6000 Turbine Head Only	1	2.2m x 2.2m x 0.6m	486kg
BOX6001 (Crate Only)	1	2.4m x 2.2m x 1.2m	450kg
Set of blade in export crate	1	2.7m x 0.7m x 0.72m	126kg
ECM6004ME/300	1	0.3m x 0.3m x 0.21m	9kg
ECM6001ME/048	1	0.6m x 0.4m x 0.26m	25kg
Zebedee Spring (5 springs per bracket)	3	0.9m x 0.8m x 0.04m	9kg per bracket

TM900/6000 – 9m Tower

Item	QTY	Dimension	Weight
Tower (9m)	1	9m x 0.75m x 0.75m;	360kg
Gin pole	1	3.6m x 0.1m x 0.1m;	70kg
FND6kW-9m foundation kit	1	1.1m x 0.9m x 0.15m	140kg
FND6kW-9m foundation kit	2	1.2m x 1.2m x 0.3m	280kg

TM1500/6000 - 15m Tower

Item	QTY	Dimensions	Weight
Tower base section	1	0.87m x 0.75m (base dimension); 0.34m (top diameter), 5m (length)	426kg
Tower middle section	1	0.36m (base diameter); 0.25m (top diameter); 5m (length)	260kg
Tower top section	1	0.28m (base diameter), 5m (length)	190kg
Gin Pole	2	0.1m (diameter) x 7.2m (length)	100kg each
Gin Pole Export Crate	1	8.1m (l) x 0.7m (w) x 0.6m (h)	280kg
Tower Export Crate	1	5.9m (l) x 0.9m (w) x 1.3m (h)	350kg

Appendix B

Tower Assembly and Erection Procedures

TM1500 TOWER ASSEMBLY AND ERECTION PROCEDURES

The mast should be handled, offloaded, assembled and erected, strictly in accordance with our instructions.

Only workmen who have had experience in the erection of high lighting mast or similar work should be employed.

Outline of Mast Assembly

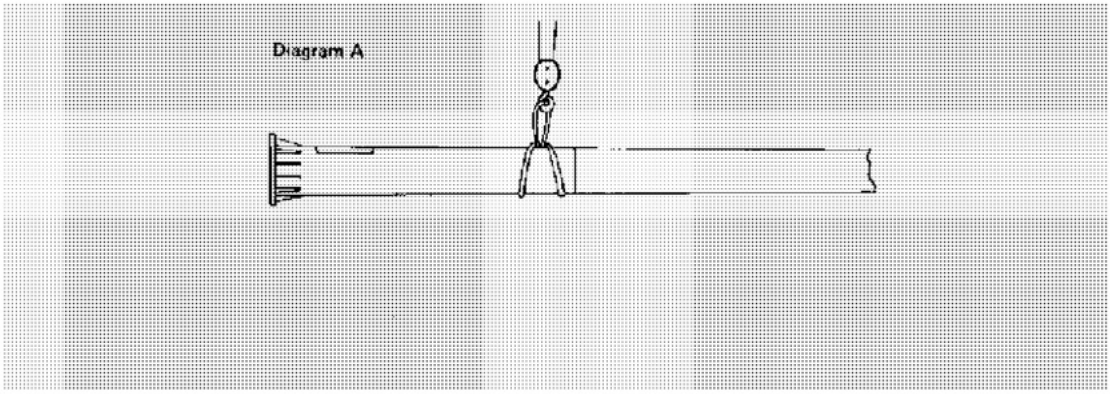
1. The joint between sections is in effect a tapered spigot and socket connection (like a fishing rod), which is first loosely assembled and then strained together into a permanent rigid assembly.
2. The order of assembly is – The base section and its adjoining section are assembled and strained together, this assembly and the next section are assembled and strained together, and so on.
3. Stress equipment consist of a steel "A" frame, a TIRFOR winch and compatible wire rope and an anchorage assembly.

Offload with Assembly Need in Mind

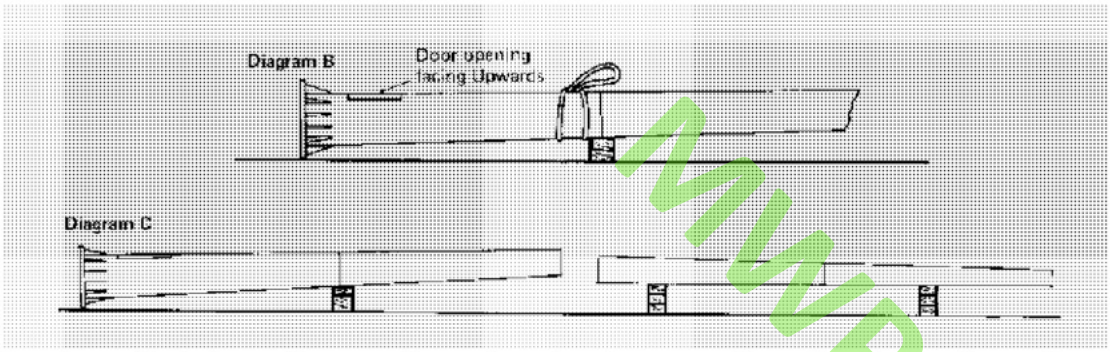
Before offloading mast sections, due consideration should be given to the assembly and erection, and each section of the mast off loaded on site accordingly. A completed mast assembly should be in a position whereby the lifting equipment can erect the mast in a single lift without transportation.

Mast Assembly Procedure

1. ASSEMBLY SITE> Assemble each mast as near as possible to its installation site, but preferably on level ground.

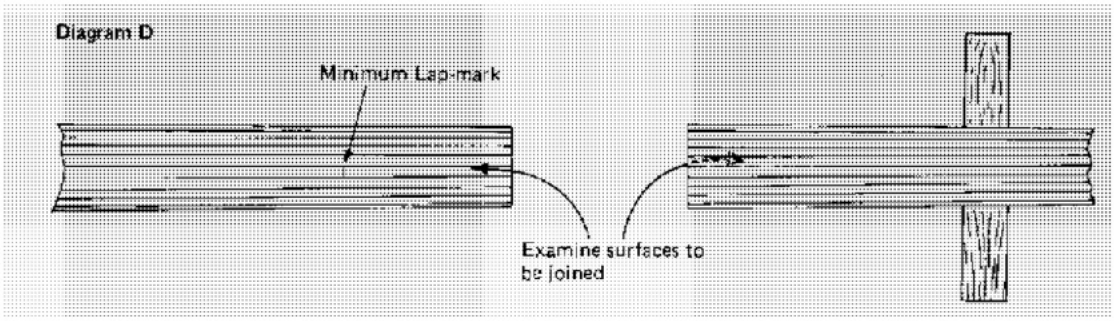


2 BASE SECTION. Determine the approximate balance point of the base section by slinging it from a crane and adjusting the sling until it balances. (See diagram A).



3 Lower the balanced base section on to a clean bearer positioned beside the sling, as in diagram B. The bearer should be high enough to support the base section at approximately the angle shown in diagram B.

4 ADJOINING SECTION. Place the adjoining mast section about 1 metre from the base section, rest it on two clean bearers (See diagram C). It is advisable to pass a rope through the sections at this stage to facilitate the later job of pulling through wire ropes and cables.



5 Examine the male and female surfaces to be joined for any foreign matter, distortion or roughness likely to prevent a satisfactory joint. (See diagram D).

6 JOINT LENGTH (LAP). Determine the minimum lap. The minimum site lap joint should be equal to 1.5 times the diameter of the female section. Measure this amount back from the male end to be joined and mark with a chalk or crayon. (See diagram D).

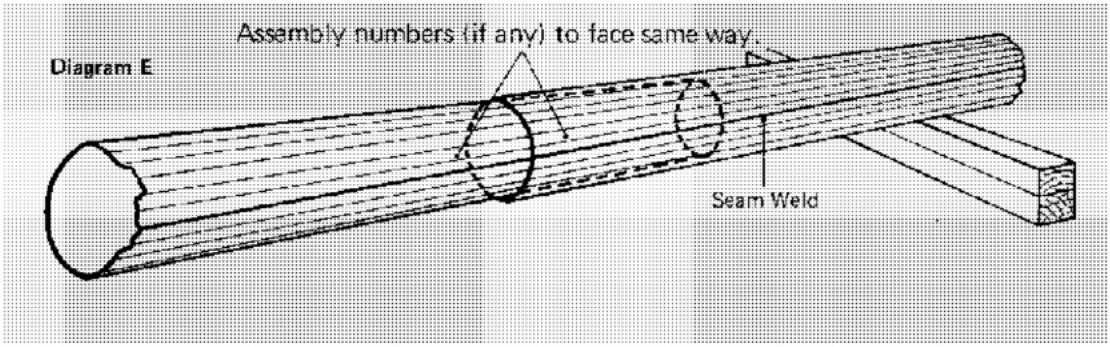


Diagram E

7 ALIGNMENT OF SEAM WELDS, ETC. Before commencing assembly, note these requirements: When assembled, the seam welds of adjoining sections must be in line and assembly numbers (if any) facing the same way (see diagram E).

8 ENGAGING SECTIONS TOGETHER. Find the balance point of the adjoining section (using sling and crane). Lift the adjoining section, advance it to the base section and engage the two ends together. You will find that the two sections will readily self-align with each other if you have them balanced and pivoted on bearer and sling as instructed. Engage the two sections as far as possible, manually.

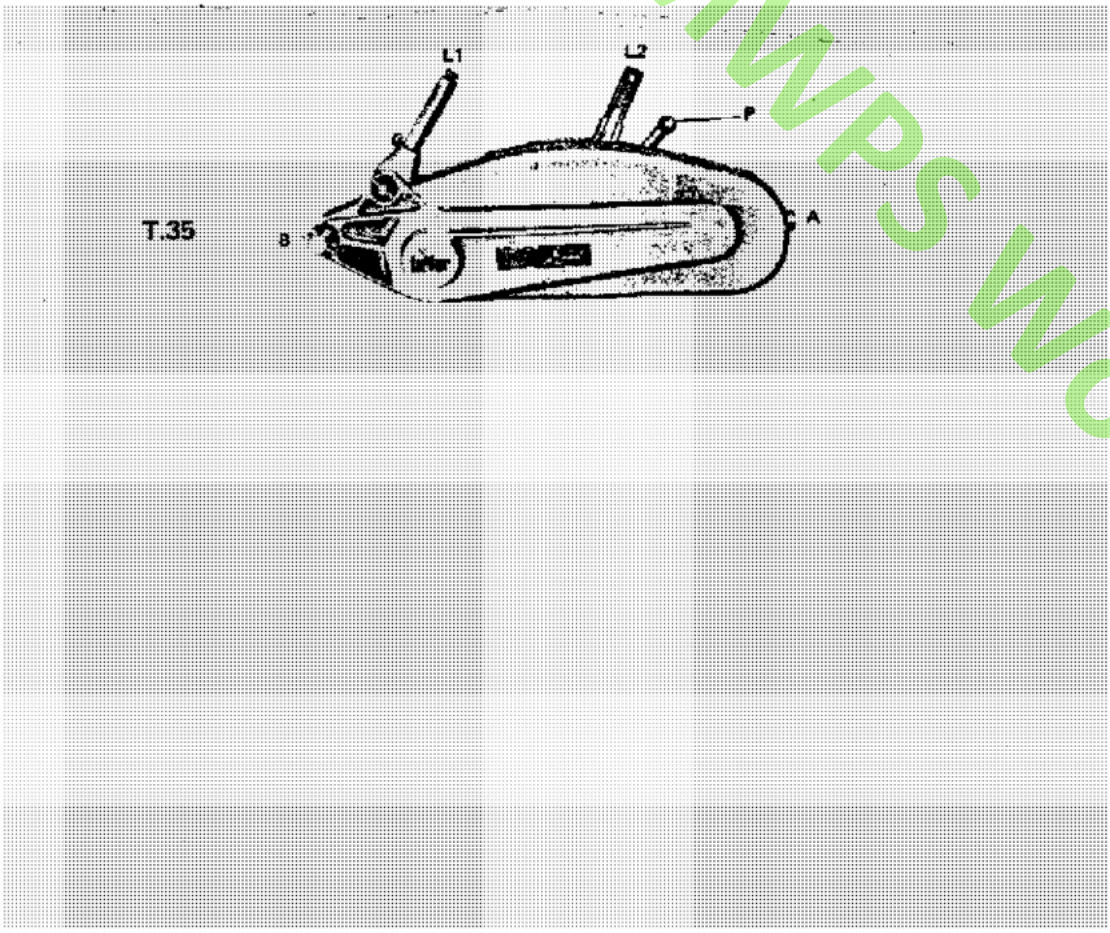


Diagram F

9 ASSEMBLING TIRFOR STRESSING GEAR. Bolt 'A' frame to base of mast as shown. A slight angle up to 30° from the horizontal in a clockwise direction will assist stressing. (See diagram G).

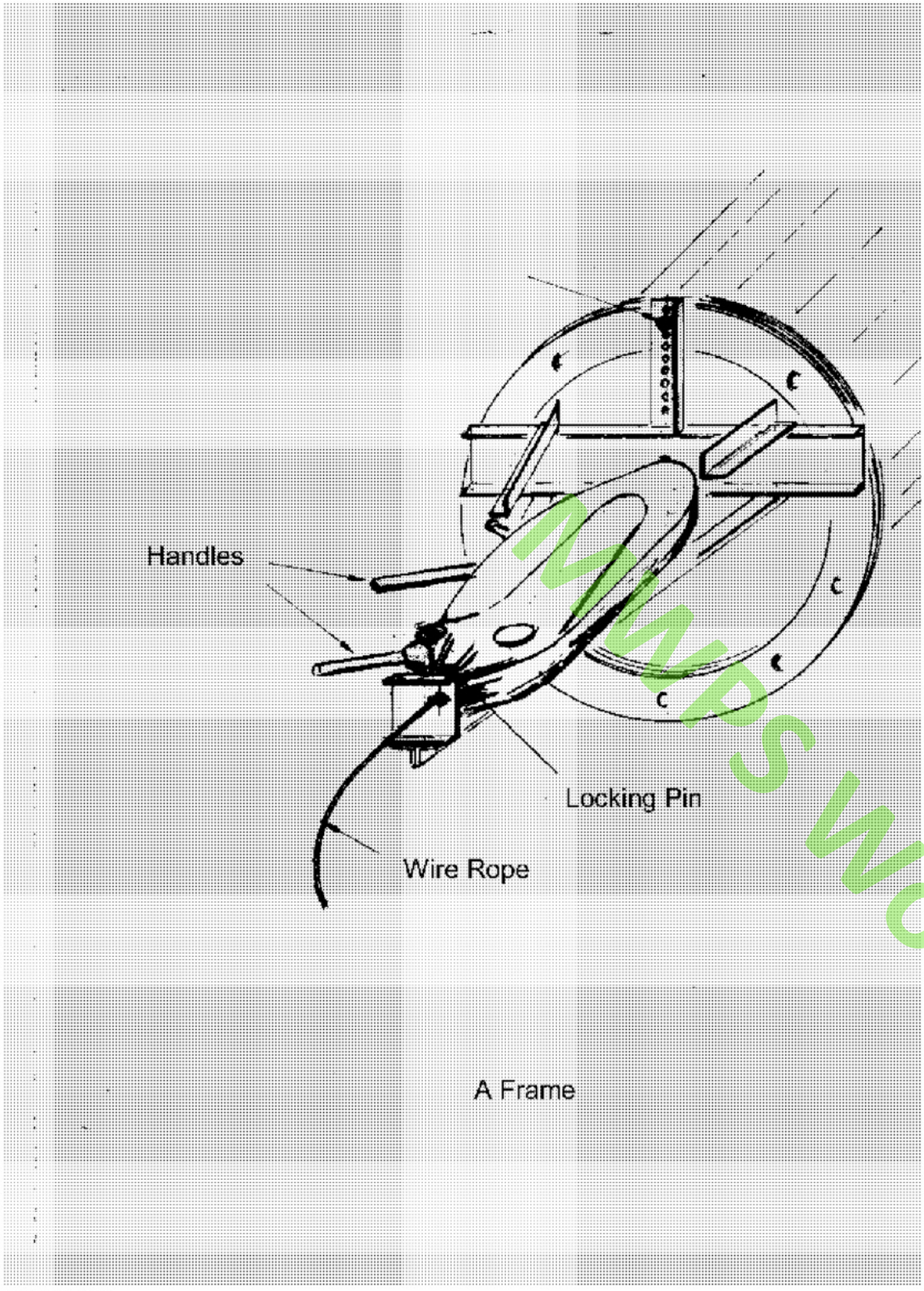


Diagram G

10 Assemble anchorage assembly at top end of section to be stressed and connect tirfor rope at the eye end. (See diagram H).

11 Pass tirfor rope through both sections of the mast from top to flange.

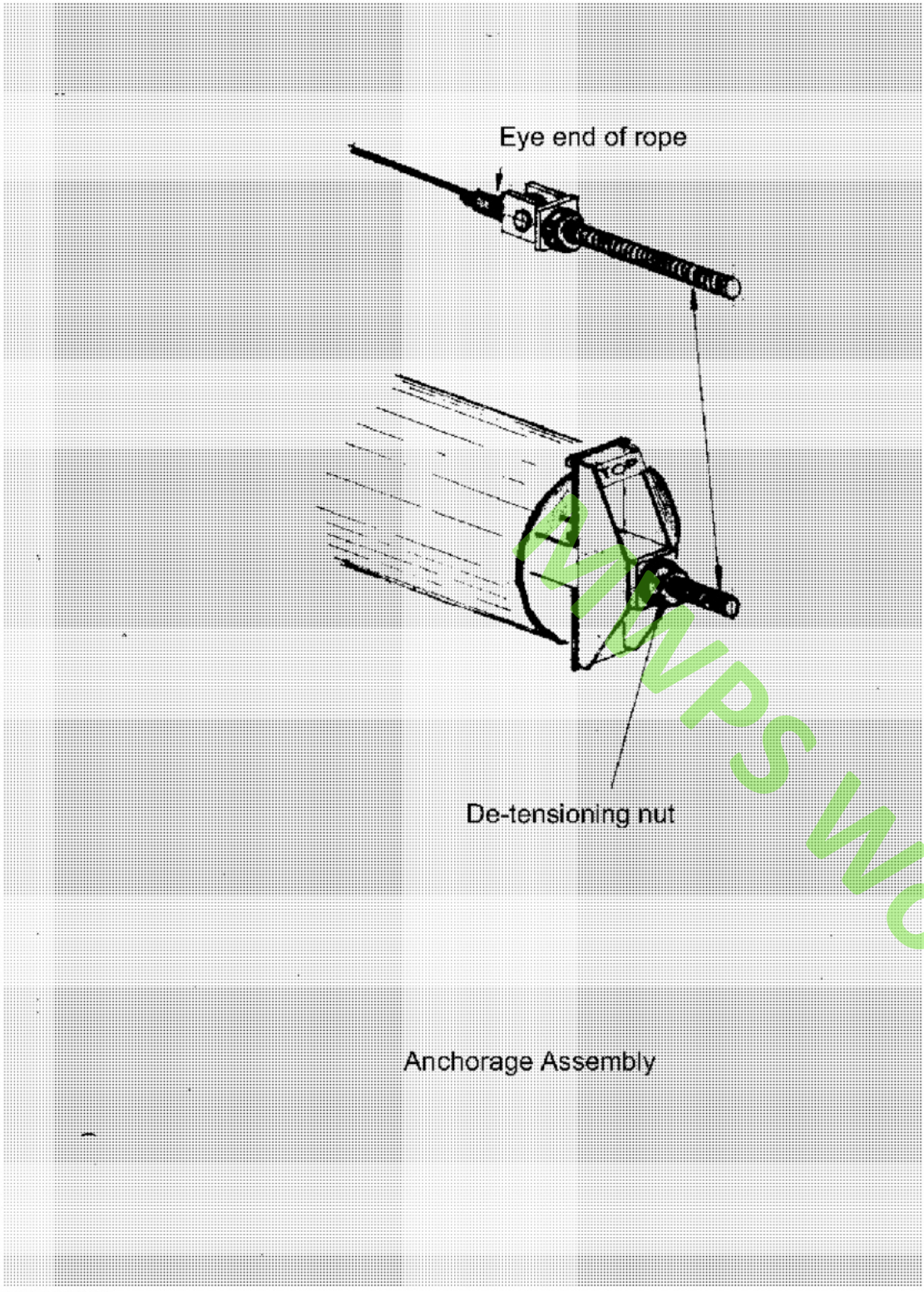


Diagram H

12 Locate the Tirfor on the 'A' frame with end 'A' towards the flange and lock into position with dowel pin 'B' with the handles just above the horizontal and to the left when facing the mast flange and looking towards the top. (See diagrams F and G).

13 Thread the tirfor rope through the Tirfor following the Tirfor Operating Instructions and making sure that at the back of the Tirfor (B) the rope passes smoothly around the dowel on the side away from the handles and through the hole on the 'A' frame.

14 Take up the slack rope and position the anchorage assembly vertically across the end of the mast. Ensure that there is sufficient thread to de-tension at this end.

Pulling Mast Together

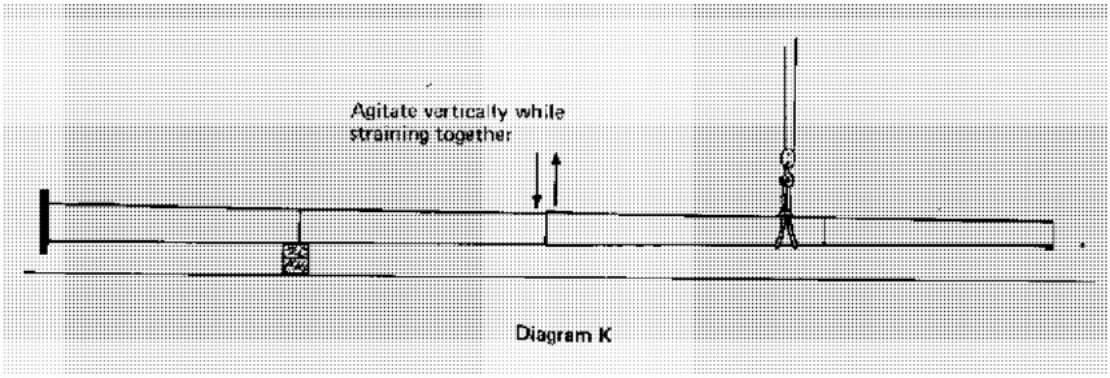


Diagram K

15 Have one or two men stressing, while another is seated astride the mast joint. His job is to agitate the joint up and down. See diagram K. This action keeps the joint advancing smoothly and reduces winding effort.

16 Continue stressing until the following requirements are achieved:
Final load applied to extended handle (i.e. 1100mm) is approximately 65kg.
Joint is a good tight fit.
Seams are aligned.
Minimum lap is exceeded.

17 De-tension either with the Tirfor, or if there is resistance by using the nut at the other end. Release more rope from the Tirfor and pull anchorage assembly out of mast. Disconnect the tirfor rope and either pull sufficient rope through the next section of mast, or pull out all rope is stressing is completed.

Further Assembly

18 THREE SECTION MAST. Regard the assembly achieved so far (two sections) as being the base section of your next assembly stage. Now go back (in the instructions) to the heading Mast Assembly Procedure.

19 FOUR SECTION MAST. First, treat as THREE-SECTION MAST until that is complete and then continue as below.

20 ASSEMBLY OF FOURTH SECTION. Support the three-section assembly on three or four bearers (depending on length); adjust alignment of bearers to support mast in a reasonably straight line.

21 The next operation is to lift the fourth section and support it in alignment with the existing assembly.

22 Check Mast Assembly Procedure paragraphs and comply with all the preparation requirements.

23 Lift the fourth section and align its slung position with the existing assembly.

24 Advance the fourth section into assembly.

25 Reassemble anchorage assembly at the top of the next section of mast, all as instructed under heading Assembling Tirfor Stressing Gear and continue as detailed from there on.

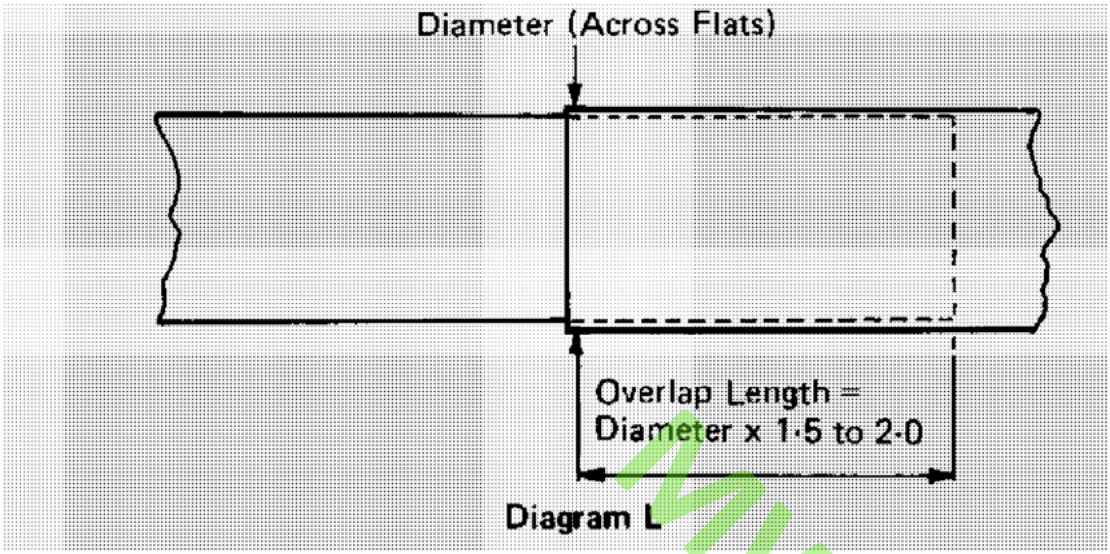


Diagram L

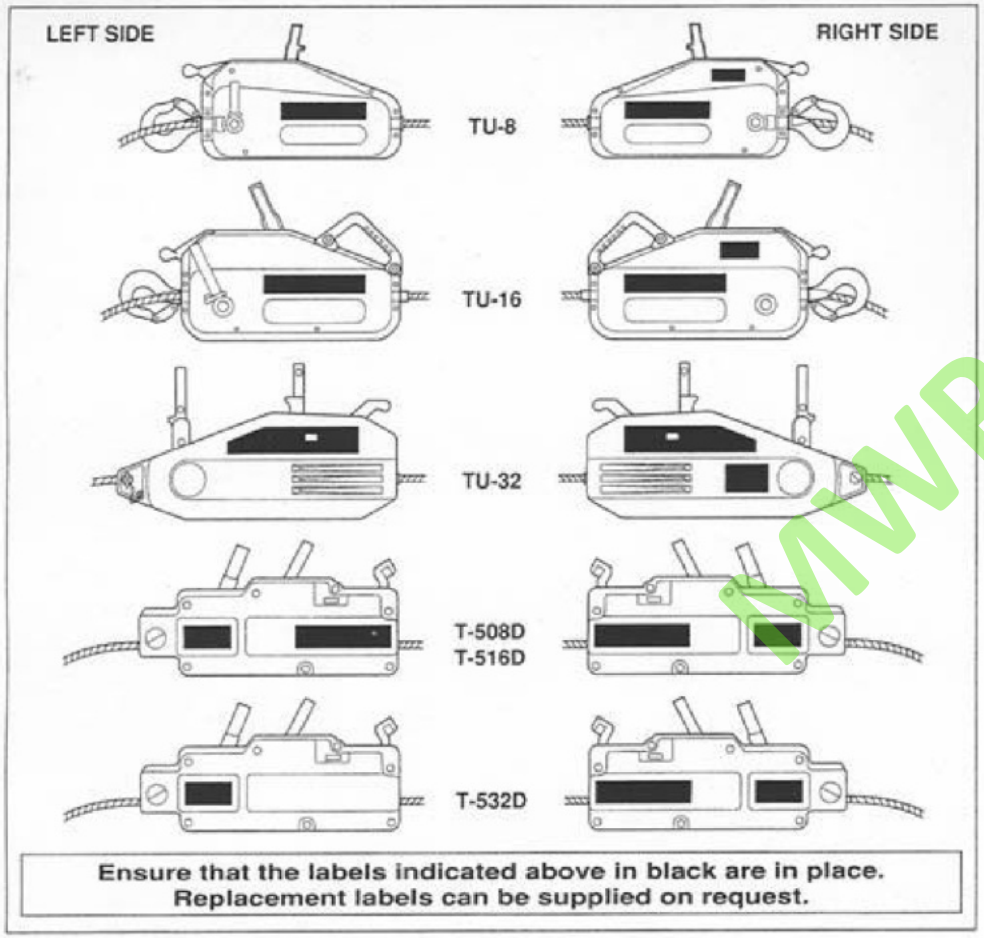
26 LENGTH OF MAST (SITE) JOINTS. The length of a site joint is related to the diameter of the joint. It will generally be between 1.5 and 2 times the diameter. See diagram L.

27 MINIMUM LENGTH OF SITE JOINTS. A lap equal to 1.5 diameters is the minimum, and to be acceptable, it must also have had the specified force exerted on it and be tight fitting as a result. IT IS NOT GOOD ENOUGH TO STOP STRAINING THE SECTIONS TOGETHER WHEN THE MINIMUM LAP HAS BEEN REACHED IF FURTHER LAP IS PRACTICAL. N.B. The above lap length should be regarded as a guide only for the vast majority of mast designs. Different lap lengths may be specified for special designs and situations, and on occasions lap lengths less than that indicated may be acceptable and guidance should be sought from the design office if required.

28 If mast is supplied without winch assembled in mast: assemble winch in mast in accordance with Fitting the CU Double Winch into a Mast (Before Erection) page 63.

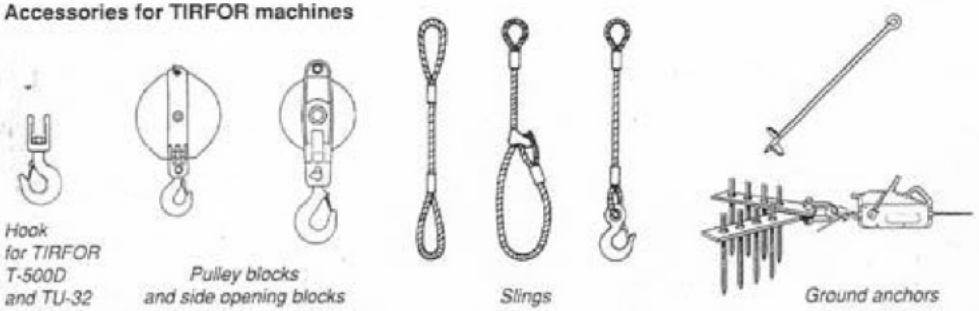
Appendix C

Lifting Equipment Instruction Sheets



Ensure that the labels indicated above in black are in place.
Replacement labels can be supplied on request.

Accessories for TIRFOR machines



Hook for TIRFOR T-500D and TU-32

Pulley blocks and side opening blocks

Slings

Ground anchors

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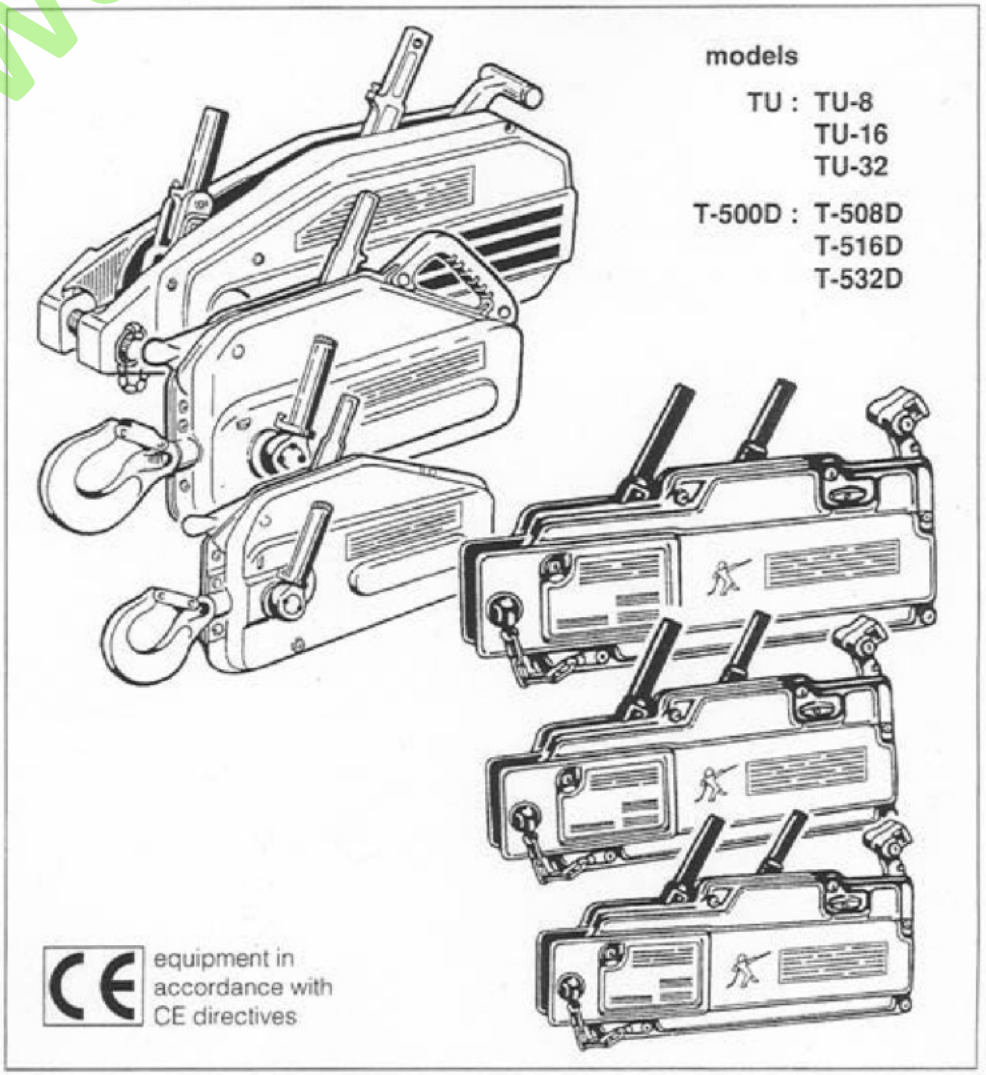
Tél. (352) 43 42 42-1
Fax (352) 43 42 42-200
ISO 9001

tirfor®

lifting and pulling machines

operating and maintenance instructions



models

TU : TU-8
TU-16
TU-32

T-500D : T-508D
T-516D
T-532D

CE equipment in accordance with CE directives

Tractel UK LTD

ORIGINAL MANUAL

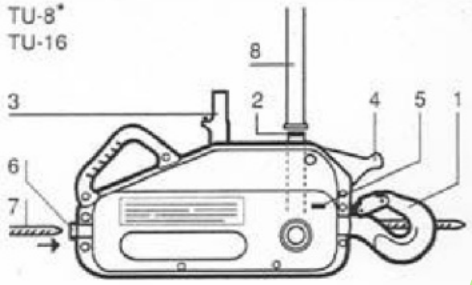
CONTENTS **Page**

Always concerned to improve the quality of its products, the TRACTEL Group reserves the right to modify the specifications of the equipment described in this manual. The companies of the TRACTEL Group and their agents or distributors will supply on request descriptive documentation on the full range of TRACTEL products : lifting and pulling machines, permanent and temporary access equipment, safety devices, electronic load indicators, accessories such as pulley blocks, hooks, slings, ground anchors, etc...

The TRACTEL network is able to supply an after-sales and regular maintenance service. Should you have any queries or require technical assistance, please do not hesitate to contact TRACTEL UK.

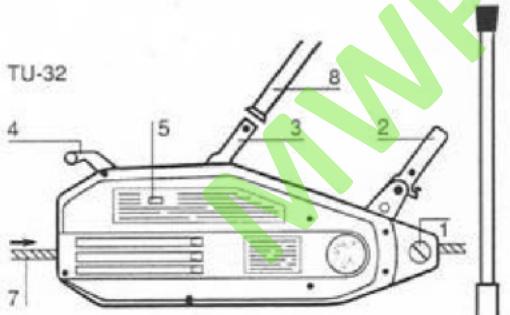
Fig. 1

TU-8*
TU-16

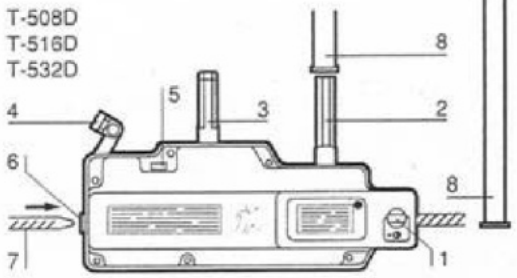


* without carrying handle

TU-32



T-508D
T-516D
T-532D



1. Hook / anchor pin
2. Forward operating lever
3. Reverse operating lever
4. Rope release lever
5. Rope release safety catch
6. Rope guide
7. Maxiflex wire rope
8. Telescopic operating handle

Wire rope on reeler

operating levers to allow the lubricant to penetrate all parts of the mechanism.

N.B. Excess lubrication cannot cause the machine or wire rope to slip.

Any machine where the side cases show signs of dents or damage, or a which the hook is damaged (models TU-8 and TU-16), should be returned to an approved repairer of TRACTEL UK.

12. ⚠ WARNINGS AGAINST HAZARDOUS OPERATIONS ⚠

The operation of TIRFOR machines, in accordance with the instructions of this manual, is a guarantee of safety. Nevertheless, it is useful to draw the attention of users to the **following warnings** :

- TIRFOR machines as described in this manual must not be used for lifting people.
- Never attempt to motorise the models of TIRFOR machines described in this manual.
- TIRFOR machines must not be used beyond their maximum working load.
- TIRFOR machines must not be used for applications other than those for which they are intended.
- Never attempt to operate the rope release mechanism whilst the machine is under load.
- Never obstruct the operating levers or the rope release lever.
- Never operate the forward and reverse operating levers at the same time.
- Never use a handle, other than the telescopic operating handle supplied, to operate the TIRFOR machine.
- It is forbidden to replace sheared pins by anything other than genuine TIRFOR shear pins of the same model.
- Never anchor the machine other than by its appropriate anchor point.
- Never obstruct the machine, which could prevent the machine, the wire rope and the anchor points from operating in a straight line.
- Never use the TIRFOR MAXIFLEX wire rope as a sling.
- Never apply a load to the loose wire rope exiting from the anchor point of the TIRFOR machine.
- Never subject the controls to sharp knocks.
- Never attempt to reverse the rope completely through the machine whilst under load.
- Do not operate the TIRFOR machine when the rope ferrule gets to within 10 cm of the machine. Otherwise the ferrule is likely to foul the casing and push the rope guide inside the machine.

13. TROUBLESHOOTING

1) The forward operating lever moves freely and does not operate the mechanism :
the machine has been overloaded and the shear pins have sheared. See section 9 for replacing the shear pins.

2) Pumping :
A lack of lubricant in a TIRFOR machine sometimes brings about a condition known as «pumping» which is not at all dangerous, but which is inconvenient. This situation occurs when the jaw which is gripping the rope becomes locked onto it preventing the other jaw from taking over the load. As the operating lever is moved in one direction the machine travels a few centimeters, but when the operating lever travels in the other direction the machine moves back the same distance in sympathy with the jaw which is locked onto the rope. The TIRFOR machine should be thoroughly lubricated and it will recommence working normally.

3. Jerkiness :
This is also a symptom of lack of lubrication. The TIRFOR machine should be thoroughly lubricated.

4. Blockage :
If the wire rope becomes blocked in the machine, generally because a damaged section of wire rope is stuck within the jaws, it is imperative to stop operating the machine. The load should be taken by another machine on a separate wire rope, or by another means, whilst ensuring that all **safety precautions** are taken. When the blocked machine is no longer under load, the damaged rope may be released and removed. Should this not be possible, return the machine and wire rope to TRACTEL UK or an approved repairer.

14. HEALTH AND SAFETY AT WORK

All lifting equipment must be supplied, operated, maintained and tested according to the applicable statutory requirements, and specially to the provisions of the Health and Safety at Work Act.

It is also the responsability of every company to ensure that their employees have been fully and properly trained in the safe operation of their equipment.

10. MAXIFLEX WIRE ROPE

⚠ **To guarantee the safe operation of TIRFOR machines, it is essential to use them exclusively with TIRFOR MAXIFLEX wire rope which has been specially designed to meet the requirements of the TIRFOR machine.**

TIRFOR MAXIFLEX wire ropes have a red strand which is visible on new rope. One end of the wire rope has an end fitting, such as a safety hook, fitted to a thimble fixed by a metal ferrule (See Fig. 21). The other end of the wire rope is fused and tapered (See Fig. 22).

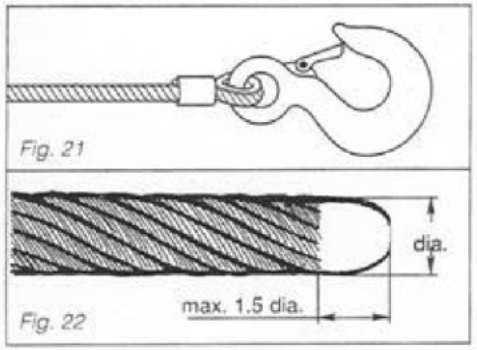


Fig. 21

Fig. 22

⚠ **A wire rope in good condition is a guarantee of safety, to the same extent as a machine in good condition**. It is necessary to continuously monitor the state of the wire rope, to clean and oil it with a rag soaked with motor oil or grease. Grease or oil containing graphite additives or molybdenum disulphide must not be used.

Visual examination of the wire rope

The wire rope should be examined daily to detect any signs of wear (damage or broken wires : See examples in Fig. 23).

In case of any apparent wear, have the wire rope checked by a competent person. Any wire rope with a reduction from the nominal diameter by more than 10% should be replaced. (See Fig. 24 for the correct method of measuring the diameter of a wire rope).

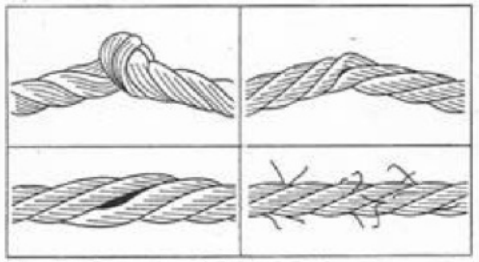


Fig. 23 - Examples of damaged wire rope

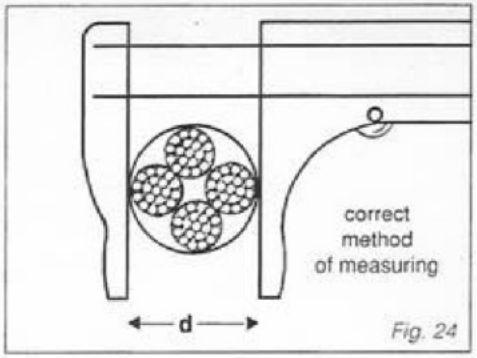


Fig. 24

IMPORTANT : It is recommended, specially for lifting applications, to ensure that the length of wire rope is greater than actually required. Allow an extra meter approximately.

When lifting or lowering loads over long lengths of wire rope, steps should be taken to stop the load from rotating to prevent the wire rope from unlaying.

Never allow a tensioned wire rope to rub over sharp edges. The wire rope must only be used with pulleys of an appropriate diameter.

Never expose the wire rope to temperatures beyond 100 degrees C.

Never use wire rope that has been subject to damage such as fire, corrosive chemicals or atmosphere, or exposed to electric current.

Storage : See section 7.

11. MAINTENANCE INSTRUCTIONS

The machine should be inspected, cleaned and lubricated at regular intervals, at least annually, by an approved TRACTEL UK repairer. Never use grease or oil containing graphite additives or molybdenum disulphide. To clean the machine, allow the machine to soak in a bath of some proprietary cleansing fluid but not acetone and derivatives or ethylene trichloride and derivatives. Then shake the machine vigorously to loosen foreign matter and turn it upside down to allow the dirt to come out through the openings for the operating levers. Allow the mechanism to drain and become dry. After this treatment, **ensure that the machine is well lubricated** by applying a quantity of oil (type SAE 90-120) onto the internal mechanism through the openings for the operating levers, and for the models TU-8 and TU-16, through the special lubrication holes. To carry out this procedure, it is best for the machine to be not under load and in the released position.

Alternatively operate the forward and reverse

⚠ GENERAL WARNING ⚠

1- **Before using the TIRFOR machine** it is essential for the safe and correct operation of the equipment **that this manual be read** and fully understood and that all the instructions be followed. **This manual should be made** available to every operator. Extra copies of this manual will be supplied on request.

2- The TIRFOR machine allows the operator to carry out work with complete safety. Ensure that this machine is only handed over for use or rigging to an operator who is trained to operate it in a responsible manner.

3- Never use a machine which is not in good working condition. **Replace any worn or damaged wire rope** (See Section 10). Continuous monitoring of the condition of the machine, its wire rope and anchor sling is an important safety consideration.

4- The manufacturer declines any responsibility for the consequences of dismantling or altering the machine by any unauthorised person. Specially excluded is the replacement of original parts by parts of another manufacturer.

5- **The models as described in this manual must not be used for lifting people.**

6- Moreover, these models are designed for manual operation and **must not be motorised**. The TRACTEL Group has designed special motorised models (TU-16H and TU-32H).

7- Never attempt to overload the machine.

8- Standard TIRFOR machines are not designed for use in explosive atmospheres.

9- **IMPORTANT** : If the equipment described in this manual is supplied to an employed person, check that you meet your obligations with respect to safety at work regulations (see page 11 - chapter 14).

LIFTING PEOPLE AND SPECIAL APPLICATIONS

TRACTEL UK markets a range of TIRFOR TUA machines (TU8A, TU16A, TU32A) specially designed for lifting people on suspended platforms. For further information on equipment for lifting people, and on any special application, please refer to TRACTEL UK.

TECHNICAL DATA

MODEL		TU-8	T-508D	TU-16	T-516D	TU-32	T-532D
Maximum working load	t	0.8		1.6		3.2	
Weight :							
machine	kg	8.4	6.6	18.0	13.5	27.0	24.0
telescopic operating handle	kg	1.0	1.0	2.4	2.3	2.4	2.3
standard 20 m of wire rope, complete	kg	6.1	6.1	13.1	13.1	26.6	26.6
Total weight of standard equipment	kg	15.5	13.7	33.5	28.9	56.0	52.9
Machine dimensions :							
length	mm	527	420	660	530	676	620
length with optional hook	mm	–	550	–	650	860	840
height	mm	265	250	330	315	330	355
width	mm	108	99	140	127	156	130
telescopic handle : closed/extended	cm	51/77	40/69	68/119	65/115	68/119	65/115
TIRFOR MAXIFLEX wire rope							
diameter	mm	8.3		11.5		16.3	
guaranteed breaking strain*	kg	4000		8000		16000	
weight per meter	kg	0.250		0.500		1.00	
Rope travel (forward/reverse)**	mm	70/76	46/63	56/70	42/57	30/48	18/36

* Including end fittings of the wire rope.

** One complete cycle of the operating lever at maximum working load.

1. DESCRIPTION OF EQUIPMENT

The TIRFOR machine is a hand-operated lifting and pulling machine. It is versatile, portable and multi-purpose, not only for pulling and lifting but also for lowering, tensioning and guying.

The originality of the TIRFOR machine is the principle of operation directly on the wire rope which passes through the mechanism rather than being reeled onto a drum of a hoist or conventional winch. The pull is applied by means of two pairs of self-energised jaws which exert a grip on the wire rope in proportion to the load being lifted or pulled. A telescopic operating lever fitted to either the forward or the reverse lever transmits the effort to the jaw mechanism to give forward or reverse movement of the wire rope.

The machine is fitted with a hook or anchor pin, depending on the model, so that it can be secured quickly to any suitable anchor point.

TIRFOR machines, intended for lifting and pulling materials, are available in two ranges each with three models of different capacities :

- T-500D range for light duty applications (with safety release catch)
- TU range for heavy duty applications (with safety release catch).

Each machine is supplied with a telescopic operating handle, and usually with a 20 m standard length of special TIRFOR MAXIFLEX wire rope fitted with a safety hook and wound onto a metal reeler. Longer or shorter lengths of wire rope are available on request.

This manual together with a guarantee card are supplied with each machine, as well as the CE declaration of conformity.

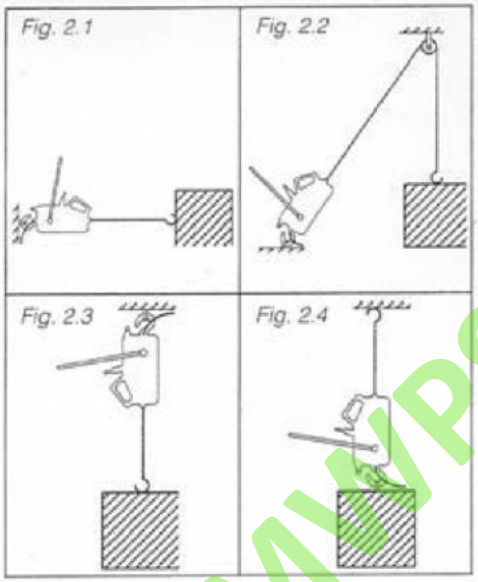
IMPORTANT : TIRFOR MAXIFLEX wire rope has been specially designed to meet the particular requirements of the TIRFOR machine. The manufacturer does not guarantee the safe operation of machines used with wire rope other than TIRFOR MAXIFLEX wire rope.

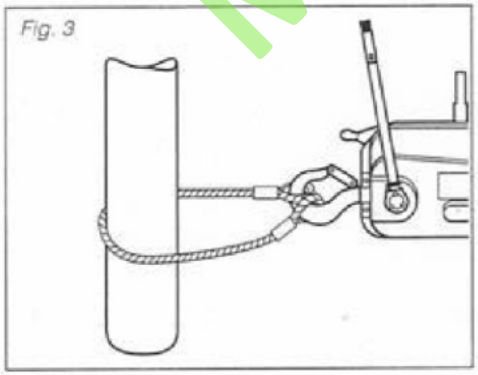
2. RIGGING ARRANGEMENTS

Various ways of rigging are shown in Figs. 2.1, 2.2, 2.3 and 2.4. Figs. 4 and 5 show particular arrangements (one forbidden and the other recommended).

The machine may be anchored to a fixed point with the wire rope travelling towards the machine (Figs. 2.1, 2.2, 2.3), or travel along the wire rope, with the load, the wire rope itself anchored to a fixed point (Fig. 2.4).

In example 2.2, the maximum working load of the pulley and the anchor point should be equal to or greater than twice the load.





N.B. Whatever the rigging arrangement, and if the machine is anchored directly to a fixed point, ensure that there are no obstructions around the machine which could prevent the wire rope, the machine and anchor from operating in a straight line. It is therefore recommended to use a sling of an appropriate capacity between the anchor point and the machine (Fig. 3).

⚠ **WARNING** ⚠ : Any rigging arrangement which requires the calculation of the forces applied should be checked by a competent engineer, with special attention to the appropriate strength of fixed point used.

For work such as guiding the trunk in tree felling, the operator should ensure that he is outside the danger area by passing the wire rope around one or more return pulleys.

8. SAFETY DEVICES

8.1 Overload limiting safety devices

All TIRFOR machines incorporate a shear pin system. In case of overload, one or more pins (depending on the model), fitted to the forward operating lever, shear and prevent further forward or lifting operations. Reverse operation is still possible to enable the load to be lowered or the wire rope to be slackened.

8.2 Rope release safety device

Models TU and T-500D are fitted with a «two-handed» rope release system which requires deliberate operation by the user to release the machine. See section 4 : «Releasing and engaging the jaws».

9. REPLACING THE SHEAR PINS

Figures 17, 18, 19 and 20 show the position of the shear pins for the various models. Spare shear pins are in the stub of the operating levers for models TU-8 and TU-16, and in the rope release lever for the other models, behind the plastic cap.

Remove the sheared pins with a suitable punch.

For models TU-8 and TU-16, remove the forward operating handle stub by using an extractor. Remove the sheared pins. Refit the forward operating handle stub on the crank and align the grooves for the shear pins (Figs. 17 and 18).

For models T-500D and TU-32, align the holes of the upper and lower sections of the forward operating lever.

Position the spare shear pin(s) and drive it/them in with a hammer.

⚠ **Warning** ⚠ **: It is forbidden to replace sheared pins by anything other than genuine TIRFOR shear pins of the same model.**

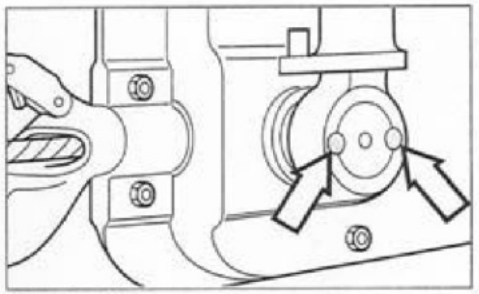


Fig. 17 - TU-8

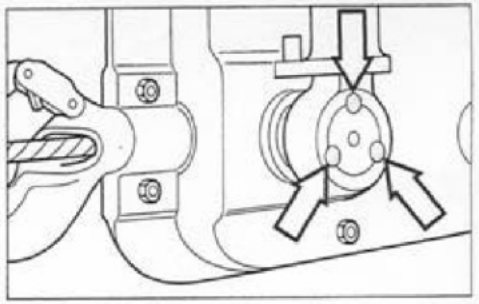


Fig. 18 - TU-16

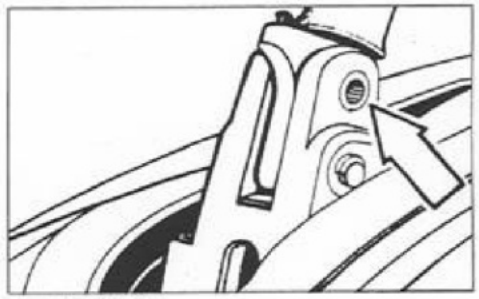


Fig. 19 - TU-32

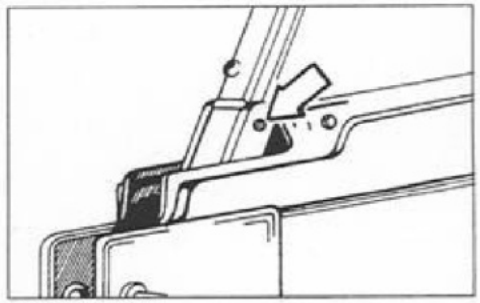


Fig. 20 - T-500D

Before putting the machine back into operation, ensure that the cause of the overload is removed. If necessary, use multiple sheave blocks (See Fig.6).

Remember to re-order sheared pins and put them back in the correct place.

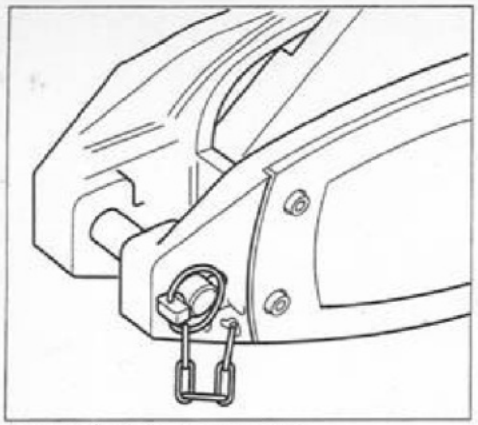


Fig. 13 - Anchor pin in position.

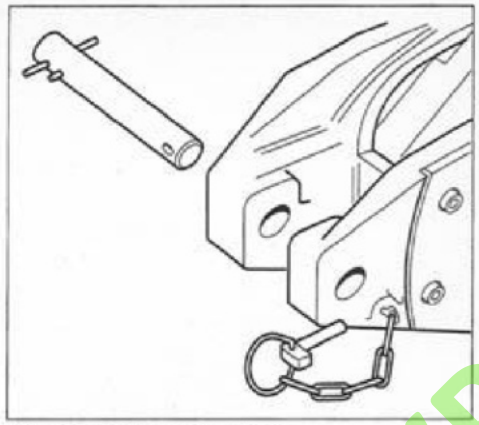


Fig. 14 - Anchor pin removed.

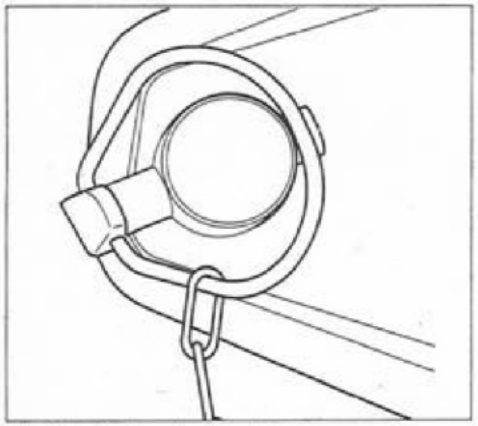


Fig. 15 - Spring clip closed.

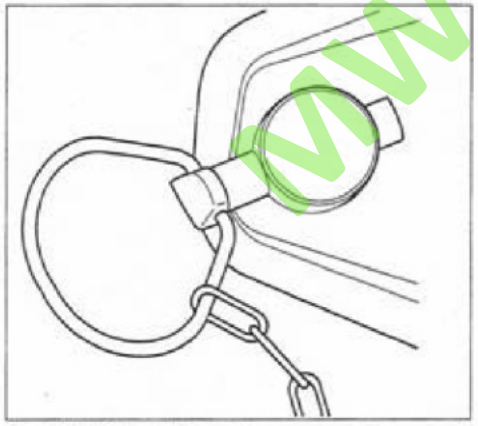


Fig. 16 - Spring clip open.

6. OPERATION

TIRFOR machines are very easy to use. Place the telescopic operating handle on either the forward or reverse operating lever, lock it into position by twisting, and move the operating handle to and fro. The operating arc is variable for ease of operation.

When operation stops, both jaws automatically grip the wire rope and hold the load which is spread equally between the jaws.

The to-and-fro operation of the forward or reverse lever gives continuous movement of the load.

7. RELEASING THE WIRE ROPE AND STORAGE

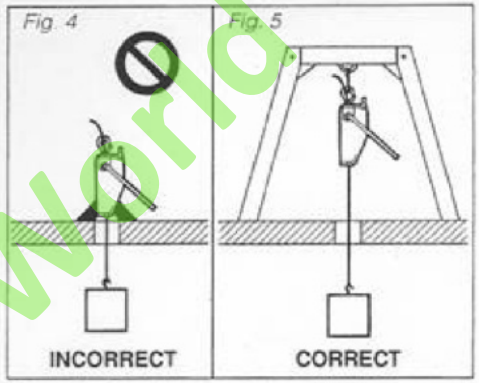
It is essential to take the load off the machine before attempting to release the jaws. To do this, operate the reverse operating lever until there is no tension in the wire rope.

Remove the telescopic operating handle and return it to the closed position.

Release the machine and follow the instructions for installing the wire rope in the reverse order. Re-engage the jaws of the machine before putting it into storage.

Store the machine and wire rope in a dry place, away from the effects of the weather. The wire rope should be completely removed from the machine and rewound onto its reeler.

Before reeling the wire rope, it is recommended to inspect it, clean it with a brush and then grease it. (See section 10).



The capacity of the machine may be increased considerably for the same effort by the operator by using multiple sheave blocks. (See the examples set out in Figs. 6.1 and 6.2). The increase in the capacity shown is reduced depending on the efficiency of the pulleys.

The diameter of the pulleys used should be equal to at least 18 times the diameter of the wire rope. (Refer to the applicable regulations).

For any rigging arrangement other than those described in this manual, please consult TRACTEL S.A.S. or a competent specialist engineer before operating the machine.

Fig. 6.1 - Pulling

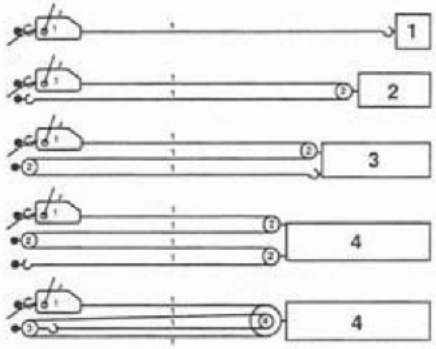
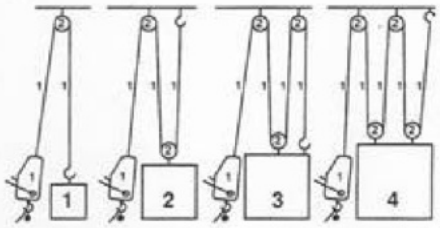


Fig. 6.2 - Lifting



3. INSTALLATING THE WIRE ROPE

N.B. When handling the wire rope it is recommended to protect the hands by using work gloves.

If the wire rope is to be anchored to a high anchor point, the wire rope should be anchored before fitting the wire rope in the machine.

1. Uncoil the wire rope in a straight line to prevent loops or kinks.
2. Release the internal mechanism (See section 4: «Releasing and engaging the jaws»).
3. Insert the wire rope through the rope guide at the end opposite to the anchor point (hook or anchor pin).
4. Push the wire rope through the machine, and if necessary, helping it by operating the forward operating lever.
5. When the wire rope appears through the anchor point, pull the slack wire rope through the machine, to the point required.
6. Engage the jaws by operating the rope release mechanism (See section 4 : «Releasing and engaging the jaws»).
7. Anchor the TIRFOR machine or the wire rope to the appropriate fixed point (See section 5 : «Anchoring») taking care to ensure that the anchor point (hook or pin, depending on the model) is correctly fixed.
8. Extend the telescopic operating handle until the spring locks into position. If necessary twist the two sections of the handle, one inside other, to align the spring (Fig. 1).
9. Replace the telescopic operating handle on the chosen operating lever (forward or reverse) and twist the handle to ensure that it is locked in position (about a half turn).

After this procedure, the machine is ready for operation, providing the load is correctly anchored to the machine or the wire rope (See section 5 : «Anchoring» and section 2 «Rigging arrangements»).

4. RELEASING AND CLOSING THE JAWS

Each machine is fitted with a lever (Fig. 1 Item 4) for releasing the jaw mechanism which should only be operated when the machine is not under load.

There are two positions for the rope release lever (See Fig. 7, 8 and 9) : released or engaged.

N.B. When not in operation, it is recommended that the rope release lever should be in the engaged position. The machine must therefore be released before attempting to feed in the wire rope.

4.1. TU-8 or TU-16 (Fig.7)

Releasing :

1. Completely press the rope release safety catch (5) and lift the rope release lever (4).
2. Release the safety catch and continue to lift the rope release lever until it locks into position. The internal mechanism is in the released position.

Engaging :

1. Lift the rope release lever slightly.
2. Press and maintain pressure on the rope release safety catch, allowing the release lever to slowly travel back to its original position. Release the safety catch. The release lever locks in position under the effect of its spring.

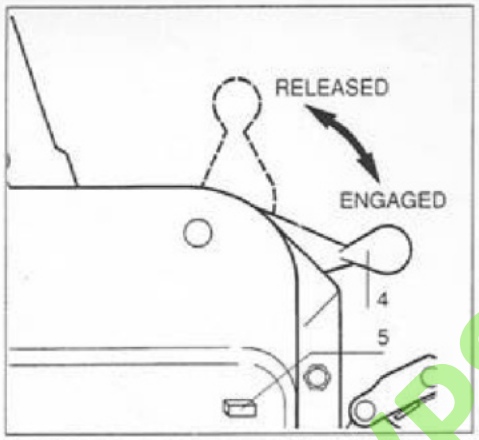


Fig. 7 - TU-8 and TU-16. Rope release lever.

4.2. TU-32 (Fig.8)

Place the anchor point against a support.

Releasing :

1. Completely press rope release safety catch (5) and push the rope release lever (4) towards the anchor point.
2. Release the safety catch and continue to push the rope release lever until it locks into position. The internal mechanism is in the released position.

Engaging :

1. Push the rope release lever towards the anchor point.
2. Press and maintain pressure on the rope release safety catch, allowing the release lever to slowly travel back to its original position. Release the safety catch. The release lever locks in position under the effect of its spring.

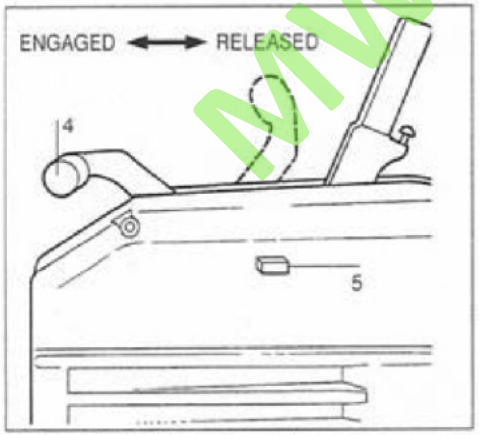


FIG. 8 - TU-32. Rope release lever.

4.3. T-500D range (Fig.9).

Place the anchor point against a support.

Releasing :

Turn the rope release safety catch (5) and push the rope release lever (4) towards the anchor pin until it locks into position when raised slightly at its limit. Release the safety catch.

Engaging :

1. Turn the rope release safety catch
2. Press the rope release lever vertically downwards, allowing the lever to travel back to its original position under the effects of its spring. Release the safety catch.

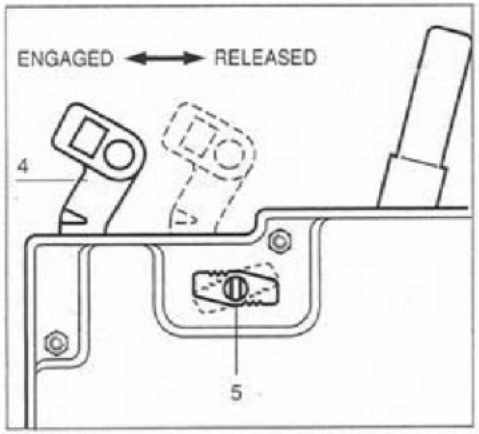


Fig. 9 - T500D range. Rope release lever

5. ⚠ ANCHORING ⚠

Failure to anchor the TIRFOR machine correctly runs the risk of a serious accident. The user must always ensure before operation that the anchor point(s) for the machine and wire-rope are of sufficient strength to hold the load.

It is recommended that TIRFOR machines should be anchored to a fixed point or to the load using an appropriate capacity sling. It is forbidden to use the machine's wire rope as a sling by passing it around the load and hooking it back onto itself (Fig.10 : incorrect anchoring arrangement; Fig.10a : correct anchoring arrangement).

The anchoring arrangement of models TU-8 and TU-16 is a hook fitted with a safety catch (Figs. 11 and 12). In all cases when anchoring the machine the safety catch of the anchor hook should be correctly closed, in its position at the tip of the hook (Fig.12). This advice for the machine anchor hook also applies to the hook fitted to the wire rope.

TIRFOR machines TU-32 and T-500D are anchored by means of a removable anchor pin, fitted across the two ends of the side cases (Fig. 13 and 14) and locked in position by a spring clip (See Figs. 15 and 16).

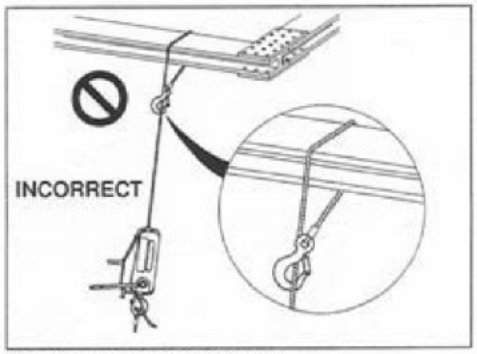


Fig. 10 - Incorrect slinging.

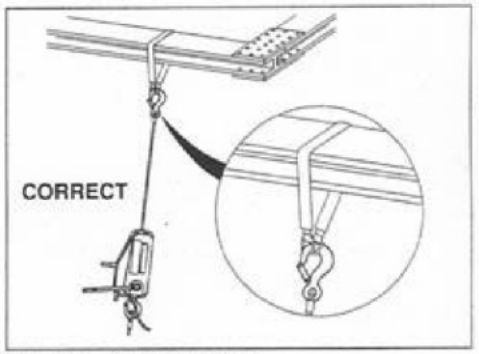


Fig. 10a - Correct slinging.

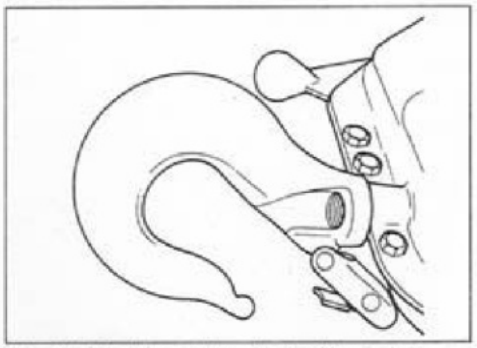


Fig. 11 - Machine anchor hook with catch in open position

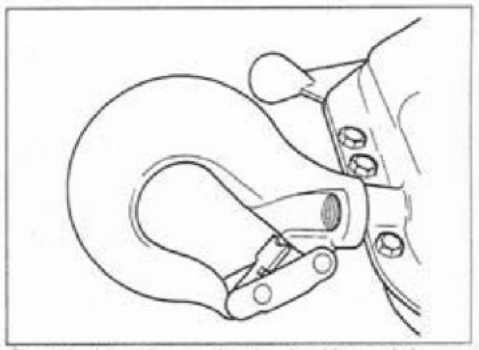


Fig. 12 - Machine anchor hook with catch in closed position.

Optional hooks are available to fit the anchor point of models T-500D and TU-32.

To anchor using the anchor pin, follow the procedure below:

1. Open the spring clip of the anchor pin.
2. Remove the spring clip from the anchor pin.
3. Slide the anchor pin out of the side cases (Fig. 14).
4. Fit the anchoring arrangement, such as a sling, between the side cases.
5. Refit the anchor pin through the side cases and anchoring arrangement, such as the eyes of a sling.
6. Refit the spring clip to the anchor pin.
7. Close the spring clip, ensuring that it fits correctly over the end of the anchor pin and cannot fall out.

⚠ **Warning** ⚠ : It is essential for the safe operation of the machine to ensure that, before loading the machine, the anchor points, hooks or pins, are correctly secured, (with the safety catch correctly located on the hook - Fig. 12).

IMPORTANT SAFETY INFORMATION

Instructions for Safe Use of: Shackles

The information in this leaflet should be passed to the user of the equipment

This document is issued in accordance with the requirements of Section 6 of the Health and Safety at Work etc Act 1974, amended March 1988. It outlines the care and safe use of SHACKLES and is based on Section 4 of the LEEA Code of Practice for the Safe Use of Lifting Equipment.* It should be read in conjunction with the requirements for general purpose slinging practice given overleaf, the principles of which may be applied to the use of shackles with or without slings.

This information is of a general nature only covering the main points for the safe use of shackles. It may be necessary to supplement this information for specific applications.

ALWAYS:

- Store and handle shackles correctly.
- Inspect shackles before use and before placing into storage.
- Select the correct pattern of shackle and pin for the application.
- Allow for the full resultant imposed load.
- Fully tighten the pin.
- Ensure the load acts through the centre line of the shackle using spacers if necessary to meet this requirement.

NEVER:

- Use shackles with bent pins or deformed bodies.
- Force, hammer or wedge shackles into position.
- Eccentrically load shackles.
- Replace the pin with a bolt.
- Fit pins in contact with moving parts which may loosen or unscrew them.
- Shock load shackles.

Selecting the Correct Shackle

Shackles are available in a range of material grades, sizes and designs. Select the shackle to be used and plan the lift taking the following into account:

Type of shackle to be used - dee or bow, British Standard or other design.

Type of pin - screwed with collar and eye are suitable for general purposes; with countersunk head for where clearance is limited; bolt and nut for where the pin may be out of sight or subject to movement.

Full resultant imposed load - when using shackles with multi-leg slings remember that as the included angle increases and so does the load in the leg and any attachment to the leg. When used to suspend pulley blocks account must be taken of the imposed load due to operating effort.

CAUTION: BS and ISO Standard shackles are designed and rated for the pin to accept a central point load. Other commonly available types are designed and rated for the load to be evenly distributed over the full width of the pin. Unless the basis for rating is clearly stated it should be assumed that the jaw must be fully filled and the load evenly spread across the shackle pin width.

Storing and Handling Shackles

Never return damaged shackles to storage. They should be dry, clean and protected from corrosion.

Do not alter, modify or repair shackles and never replace missing pins with unidentified pins, bolts etc, but refer such matters to a Competent Person.

Never galvanise or subject a shackle to other plating processes without the approval of the supplier.

Using Shackles Safely

Do not attempt lifting operations unless you understand the use of the equipment, the slinging procedures and the mode factors to be applied.

Do not use defective shackles or unidentified pins.

Shackles should be fitted so that the body takes the load along its centre line and is not subjected to side bending loads. When connecting a number of sling legs, and similar applications, position them so that they do not impose a side load on the shackle jaws. Use spacers to position them if necessary.

Ensure the pin is correctly screwed into the shackle eye. Tighten by hand, use a small bar to lock the collar to the shackle eye. Check that the thread is fully engaged with the body but is not too long so that tightening causes the body to deform.

With bolt and nut pins ensure the nut jams on the inner end of the thread and not on the eye of the shackle. The bolt should be free to rotate with minimal side float. The split cotter pin must be fitted before making a lift.

When using shackles with slings in choke hitch, or in other applications where there may be movement, place the pin through the eye or link of the sling and never in contact with the bight of the choke or moving parts which may cause the pin to unscrew.

In-service Inspection and Maintenance

Maintenance requirements are minimal. Keep shackles clean, the threads free of debris and protect from corrosion.

Regularly inspect shackles and, in the event of the following defects, refer the shackle to a Competent Person for thorough examination: illegible markings; distorted, worn, stretched or bent body; bent pin; damaged or incomplete thread forms; nicks, gouges, cracks or corrosion; incorrect pin; any other defect.

Further information is given in:

* *The Code of Practice for the Safe Use of Lifting Equipment, published by:*

LIFTING EQUIPMENT ENGINEERS ASSOCIATION,

Waggoners Court, The Street,
Manuden, Bishop's Stortford,
Herts, CM23 1DW.
Tel: 01279 816504 Fax: 01279 816524

IMPORTANT SAFETY INFORMATION

Instructions for Safe Use of: Winches Used For Lifting

The information in this leaflet should be passed to the user of the equipment

This document is issued in accordance with the requirements of Section 6 of the Health and Safety at Work etc Act 1974, amended March 1988. It outlines the care and safe use of WINCHES USED FOR LIFTING and is based on Section 19 of the LEEA Code of Practice for the Safe Use of Lifting Equipment.* It should be read in conjunction with the requirements for lifting appliances for general purposes, given overleaf, which form an integral part of these instructions.

This information is of a general nature only covering the main points for the safe use of winches used for lifting. It may be necessary to supplement this information for specific applications.

ALWAYS:

- Store and handle winches correctly.
- Inspect the winch, rope and accessories before use and before placing into storage.
- Ensure mounting and suspension points are secure and suitable for the full loads that will be imposed.
- Lift the load just clear, halt for a short period to ensure the integrity of the brake or sustaining mechanism before completing the lift.
- Use a speed appropriate to the specific application.
- Keep hands and feet clear of ropes, drums etc.

NEVER:

- Raise loads by revolving the drum in the opposite direction to that indicated.
- Use winches with loose or insecure handles.
- Use the pawl to arrest descending loads.
- Use winches if the rope is twisted or trapped.
- Over wind the rope on or off the drum.
- Use winches for man-riding applications unless they are specifically designed for that purpose.

Selecting the Correct Winch

Winches are available for manual or power operation in a range of capacities, designs and mounting arrangements. Select the winch to be used and plan the lift taking any statutory requirements and the following into account:

Type of winch - manual, electric, pneumatic or other operation - mounting, eg wall, floor, lorry etc - capacity and rope drum storage etc.

Speeds and control - single speed, dual speed - push button, pull cord, lever, remote etc.

Rigging arrangement - diverters, pulley blocks - anchorage and suspension points - imposed loads.

Consult the supplier if the winch is to be used in areas of high risk, exposed to the elements, water, steam etc, with hazardous substances, eg acids or chemicals, or subjected to extremes of temperature.

Storing and Handling Winches

Never return damaged winches, ropes etc to storage. They should be dry, clean and protected from corrosion.

With winches used for temporary applications, remove the rope for separate storage or wind it fully onto the drum and lash in position to prevent damage.

With winches left in situ, remove pulleys etc and wind the rope fully onto the drum. Where this is not possible, pulleys etc should be positioned to protect them from damage and so as not present a danger to persons or other equipment. Isolate any power supply.

Installing and Commissioning

Follow the specific instructions for installation and commissioning issued by the supplier. Handle the rope carefully. If the winch fails to operate correctly contact the supplier.

Using Winches Safely

Do not use defective winches, ropes, pulleys etc.

Check the rigging arrangement, that mounting and suspension points are secure and adequate for the imposed loads. Do not use timber bearers. Ensure sheaves are correct for size and type of rope, that fleet angles are not too great, the rope is not twisted and the load is free to move. Check operating handles are secure.

Raise the load just clear, halt the lift to ensure the integrity of the brake, slinging arrangement etc.

With manual winches, only the slow speed should be used to raise/lower loads. With power operated winches, select a speed appropriate to the specific lifting operation.

Ensure oil, water or other foreign matter does not come into contact with lined brakes.

If the direction of rotation is indicated the winch must raise the load when turning in that direction.

Check the rope and load travel paths are clear and you have a clear view so as to avoid accidents or collisions. Do not over wind the rope on or off the drum. Two turns must always remain on the drum. (This is a requirement of the Construction (Lifting Operations) Regulations however some manufacturers design for more and their recommendations must be followed.)

Keep clear of ropes, pulleys, drums and other moving parts.

In-service Inspection and Maintenance

Follow the specific instructions for maintenance issued by the supplier. These should be incorporated into the site maintenance programme observing any particular needs due to the site or working conditions.

Regularly inspect the winch and, in the event of the following defects, refer to a Competent Person for thorough examination: mounting insecure; loose or missing bolts; winch frame distorted; rope drum flanges chipped or cracked; rope anchorage loose or pulled; ratchet or pawl worn; brake worn or slipping; rope worn, or winding incorrectly; broken wires; gears worn, or not positively locating; any other visible damage, corrosion, defects or operational faults.

Further information is given in:

* *The Code of Practice for the Safe Use of Lifting Equipment, published by:*

LIFTING EQUIPMENT ENGINEERS ASSOCIATION,

Waggoners Court, The Street, Manuden, Bishop's Stortford, Herts, CM23 1DW.
Tel: 01279 816504 Fax: 01279 816524

IMPORTANT SAFETY INFORMATION

INSTRUCTIONS FOR SAFE USE OF WIRE ROPE GRIPS

The information in this leaflet should be passed to the user of the equipment

As a result of the shortcomings in B.S. wire rope grips as evidenced by research carried out by the Health and Safety Executive, the relevant standard i.e. B.S.463:1983 has been withdrawn.

CERTEX (UK) market wire rope grips in accordance with D.I.N. 1142. These grips have also been extensively tested by H.S.E and have been found to be efficient when installed correctly.

Having a flat faced bridge the D.I.N. 1142 grip is compatible with six, eight and multistrand ropes in either right or left hand lay.

Required number and torque.

Nominal size	Required number of wire rope grips to attain 85% of rope min. Breaking load	Required tightening torque to attain required efficiency (N.m)
5	3	2.0
6.5	3	3.5
8	4	6.0
10	4	9.0
13	4	33.0
16	4	49.0
19	4	68.0
22	5	107.0
26	5	147.0
30	6	212.0
34	6	296.0
40	6	363.0

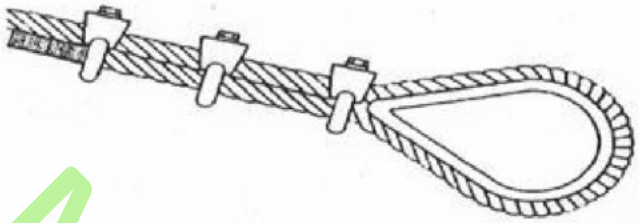
For intermediate sizes of rope the next largest grip size should be used in conjunction with the corresponding torque .

The nominal size 5 grip should not however be used on ropes having nominal diameters of less than 4.0 mm.

Fitting

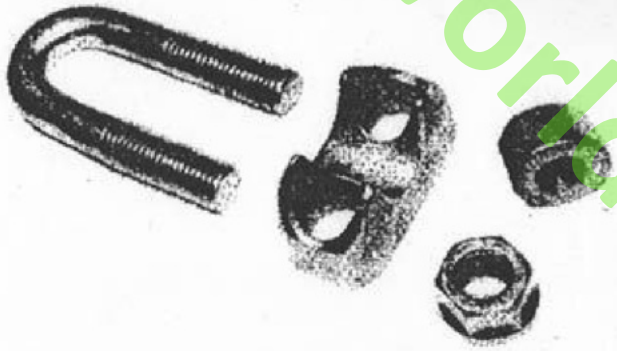
The first grip must be placed immediately against the thimble. The grips must be placed so that they are separated by a distance of approximately six rope diameters

The "U" bolt must always be placed on the tail end of the rope (non load bearing end)



During assembly and before the rope is taken into service, the nuts must be tightened to the prescribed torque. After application of the load, the torque must be checked and if necessary, be corrected.
This action should be repeated within 24 hours of installation.

Further periodic checking and re-torquing of the nuts is essential during service, particularly during the early stages of operation to ensure that the terminal efficiency is maintained



Further details on D.I.N. 1142 grips can be obtained from your local CERTEX (UK) sales office.

CERTEX
Lifting Products and Services

Appendix D

Warranty Document

UK Warranty

Proven Wind Energy Products are carefully designed, manufactured, tested and inspected. In consequence we undertake to replace any part found to be defective in material or workmanship free of charge for a period of two years from delivery to the end user. This warranty covers only those products manufactured by Proven Energy Limited.

General Conditions: This warranty does not cover damage to Proven Wind Energy Products resulting from unauthorised alteration or modification, accident, misuse, improper installation, operation or maintenance or failure to conduct periodic inspections and maintenance. Proven Energy Limited reserves the right to repair or replace the defective component(s) at their sole option. Proven Energy Limited does not accept any additional liability for defects from reasonable wear and tear.

Use of Proven Wind Turbines with Mast or Towers manufactured by others: Poor mast design may cause vibration both in the mast and the nacelle of the wind turbine. Faults arising from poor mast design shall be classed as improper installation (see General Conditions). Mast should be designed to avoid resonance within the operating frequency range of the wind turbine. The onus shall lie with the owner to show their mast has not caused the fault.

Shipping and Transport Costs: Warranty repairs will be made at the premises of Proven Authorised Representatives or our factory. The end user must return the defective component(s) properly packed, and with all freight and insurance charges prepaid. All freight, shipping and insurance costs including duties, taxes and import charges incurred in returning Proven Wind Energy Products are to be met by end user.

Disclaimer: Proven Energy Limited shall not be liable for any incidental or consequential damages resulting from the proper or improper use, for any purpose whatsoever, of Wind Energy Products.

Statutory rights: This warranty in no way diminishes the end user's statutory or legal rights.

Actions in the Event of a Defect Occurring During Warranty Period: In the unlikely event of a defect arising, first ensure the safety of people and equipment by electrical disconnection and application of the wind turbine brake, as appropriate. Please notify the Proven Service Department, or the Proven Authorised Representative immediately who will advise on the correct procedure.

Minor Faults: f the fault is a minor one and can be rectified by replacing components which could be simply fitted by the end user or a local fitter, then a replacement part will be sent as soon as possible by post or courier.

Serious Faults: In the unlikely event of a serious fault, Proven Energy Limited or a Proven Authorised Representative will arrange for an engineer to attend the, if required, and rectify the fault. The work will be charged at standard rates if the conditions of the Proven Warranty as set out above do not apply.

Warranty on other Products Supplied (but not manufactured) by Proven Energy Limited will be followed in accordance with the manufacturers recommendation.

Proven Energy Ltd, Wardhead Park, Stewarton, KA3 5LH, Scotland, UK

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Reg. in Scotland No. 71400

Export (Outside UK) Warranty

Proven Wind Energy Products are carefully designed, manufactured, tested and inspected. In consequence we undertake to replace any part found to be defective in material or workmanship free of charge for a period of two years from delivery to the end user. This warranty covers only those products manufactured by Proven Energy Limited.

General Conditions: This warranty does not cover damage to Proven Wind Energy Products resulting from unauthorised alteration or modification, accident, misuse, improper installation, operation or maintenance or failure to conduct periodic inspections and maintenance. Proven Energy Limited reserves the right to repair or replace the defective component(s) at their sole option. Proven Energy Limited does not accept any additional liability for defects from reasonable wear and tear.

Use of Proven Wind Turbines with Mast or Towers manufactured by others: Poor mast design may cause vibration both in the mast and the nacelle of the wind turbine. Faults arising from poor mast design shall be classed as improper installation (see General Conditions). Mast should be designed to avoid resonance within the operating frequency range of the wind turbine. The onus shall lie with the owner to show their mast has not caused the fault.

Shipping and Transport Costs: Warranty repairs will be made at the premises of Proven Authorised Representatives or our factory. The end user must return the defective component(s) properly packed, and with all freight and insurance charges prepaid. All freight, shipping and insurance costs including duties, frees, taxes and import charges incurred in returning Proven Wind Energy Products are to be met by end user.

Disclaimer: Proven Energy Limited shall not be liable for any incidental or consequential damages resulting from the proper or improper use, for any purpose whatsoever, of Proven Wind Energy Products.

Statutory rights: This warranty in no way diminishes the end user's statutory or legal rights.

Actions in the Event of a Defect Occurring During Warranty Period: In the unlikely event of a defect arising, first ensure the safety of people and equipment by electrical disconnection and application of the wind turbine brake, as appropriate. Please notify the Proven Service Department, or the Proven Authorised Representative immediately who will advise on the correct procedure.

Minor Faults: If the fault is a minor one and can be rectified by replacing components which could be simply fitted by the end user or a local fitter, then a replacement part will be sent as soon as possible by post or courier. For some locations, it will be the customer's responsibility to arrange transport of these parts from our Stewarton factory site.

Serious Faults: In the unlikely event of a serious fault, the turbine should be packed in sturdy export crate and shipped to our Stewarton factory. All shipping charges shall be responsibility of the customer. An appraisal will then be carried out to determine whether works required are covered under warranty and customer advised. Any works required which are not covered under Proven Warranty will be charged at standard rate. ***Warranty on other products supplied by (but not manufactured) by Proven Energy Limited will be followed in accordance with the manufacture recommendation.***

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BOLT TORQUES

Turbine	Where	Bolt Size & material	Torque
WT2500	Brackets – metal on metal – 75% of bolt proof stress	M8 A2.70 (Stainless)	25 Nm
	Brackets and blades – bolt passing through hinge rubber material	M8 A2.70 (Stainless)	25 Nm
	TM650 Tower base – 75% of bolt proof stress	M20 G8.8	441 Nm – LUBRICATED BOLTS
	TM1100 Tower base – 75% of bolt proof stress	M24 G8.8	686 Nm – LUBRICATED BOLTS
WT6000	Brackets – metal on metal – 75% of bolt proof stress	M10 A2.70 (Stainless)	35 Nm
	Brackets and blades – bolt passing through hinge rubber material	M10 A2.70 (Stainless)	25 Nm
	TM900 Tower base – 75% of bolt proof stress	M24 G8.8	686 Nm – LUBRICATED BOLTS
	TM1500 Tower base – 75% of bolt proof stress	M30 G8.8	1363 Nm – LUBRICATED BOLTS

BLADE CHECK

A check needs to be made that the blades have been set-up correctly.

1. Flex the blade until its tip is exactly in line with the hub plate, if possible with a straight edge, otherwise by eye. (If it is not lined up, the tip will be at a different angle!)
2. Sight down the length of the blade so that only the tip end can be seen
3. Is the blade mounted the right way round? The flat surface should face upwind (toward the generator), the curved surface downwind.
4. There should be a small angle between the blade profile as seen in this position and the hub plate
5. The leading edge (the rounded 'nose' of the profile) should be angled very slightly upwind (toward the generator), the trailing edge (the sharp edge) should be very slightly downwind