PROVEN 2.5/TM1100/TM650

(PROVEN2.5 – 024v/048v – 2007REV.01)

2.5KW BATTERY CHARGING

INSTALLATION, OPERATION & MAINTENANCE MANUAL

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1.0 Introduction

1.1 System Description

The PROVEN 2.5 wind turbine generator has a rated output of 2500W at 48V AC.

The PROVEN 2.5 is downwind three bladed wind turbine. It comprises a steel turbine frame mounted on a steel tower assembly. The turbine frame supports encapsulated windings and bearings that in turn support a rotating shaft and permanent magnet rotor assembly. One end of the shaft has a propeller blade assembly comprising three polypropylene blades that are hinged on a rotor plate. The blades are held in their correct position by springs that allow the blades to form a cone shape in high winds. In this shape, the turbine is able to limit its overspeed. The turbine frame also houses a service brake assembly that acts upon a brake attached to the rotor shaft.

The turbine is supplied with a self supporting tilt up tower which is connected to the turbine frame. The tower has a steel baseplate that incorporates a raising and lowering hinge mechanism. The brake lever mounted inside the tower is connected to the service brake in the turbine head frame.

The top of the tower has a yaw bearing and yaw rubber assembly that permits the turbine frame to rotate. Thus turbine is able to rotate freely into the wind as the wind direction changes. The speed of rotation of the blades is depended on wind speed.
The generator encapsulated stator windings are connected to a slip ring unit at the top of the tower for onwards connection to a certified junction box.

1.2 System Components

The main system components for the PROVEN 2.5 wind turbine generator are:

- Turbine head assembly (including generator)
- Set of polypropylene blades (3 off)
- Slip ring assembly
- Tower and gin pole assembly
- Wind turbine controller with junction box and cable kit

Contained within the hollow tower section are the following components;

Turbine Brake Rope – 6sq mm diameter brake rope with stainless clamps, eyes and bracket.

Power Cable - Between slip-ring unit at the tower top and the junction box at the bottom of tower: 1 x 3 core 16sq mm PVC cable.

1.3 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

1.4 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 recommend 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.

2.0 Electrical Installation

Electrical installations are to be carried out according to the layout, installation drawings and instructions highlighted in the sections below.

2.1 Turbine Output Cable

Turbine output cable should be rated to suit the environmental conditions along its entire route. Proven recommends 3 – core steel wired armoured cable (SWA). The SWA cable need not be enclosed in trucking but where the site conditions dictates, trucking may be used.

The SWA cable should be sized to ensure that the voltage drop along the cable does not exceed 4%.

2.2 Electrical Schematic Drawing

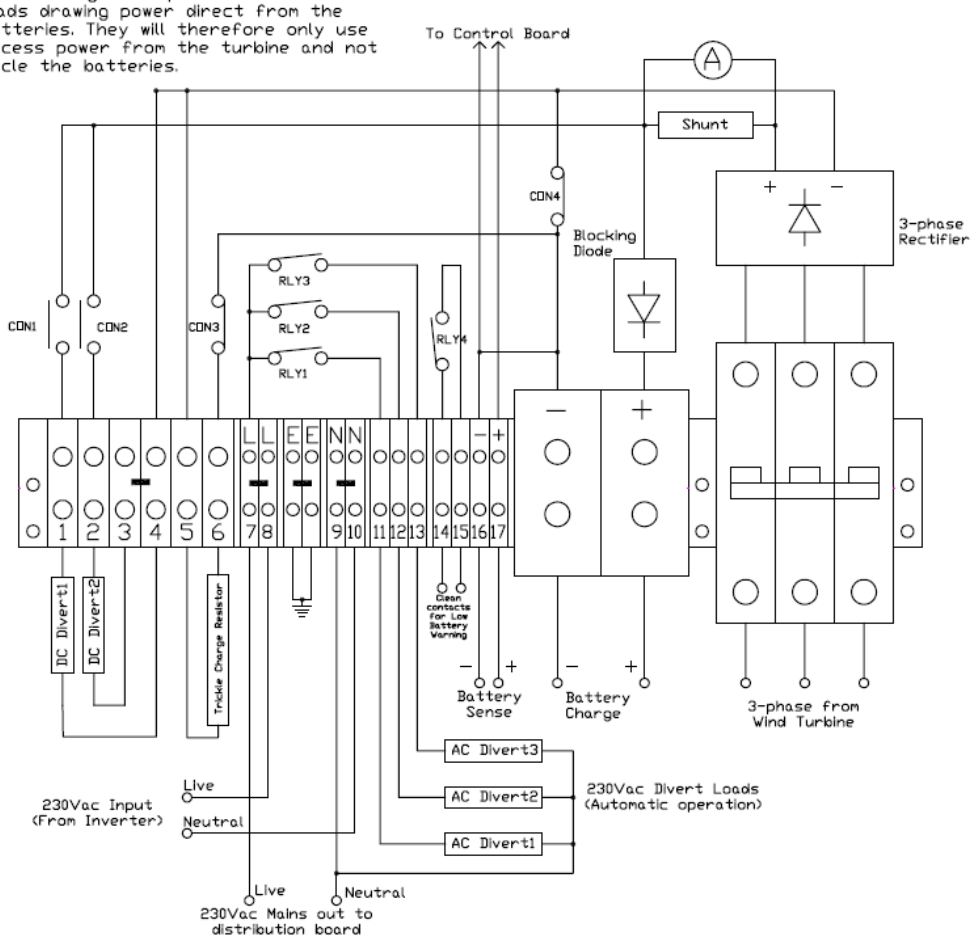
Contactors CON1 and CON2 are normally open.
Relays RLY1, RLY2, RLY3 and RLY4 are normally open.
All relays and contactors are operated from the control board which monitors the battery voltage.
CON3 and CON4 are normally closed. As battery voltage rises CON4 opens causing the charging current to pass through the trickle charge resistor. If CON3 opens the turbine output is disconnected from the batteries.
The blocking diode prevents the DC loads drawing power direct from the batteries. They will therefore only use excess power from the turbine and not cycle the batteries.

Customer Name:

Location:

WT Serial Number:

ECM Serial Number:



Notes:

The trickle charge resistor is wall mounted close to the control box. (e.g. above the box)

WARNING this resistor will get HOT!

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

PROVEN ENERGY

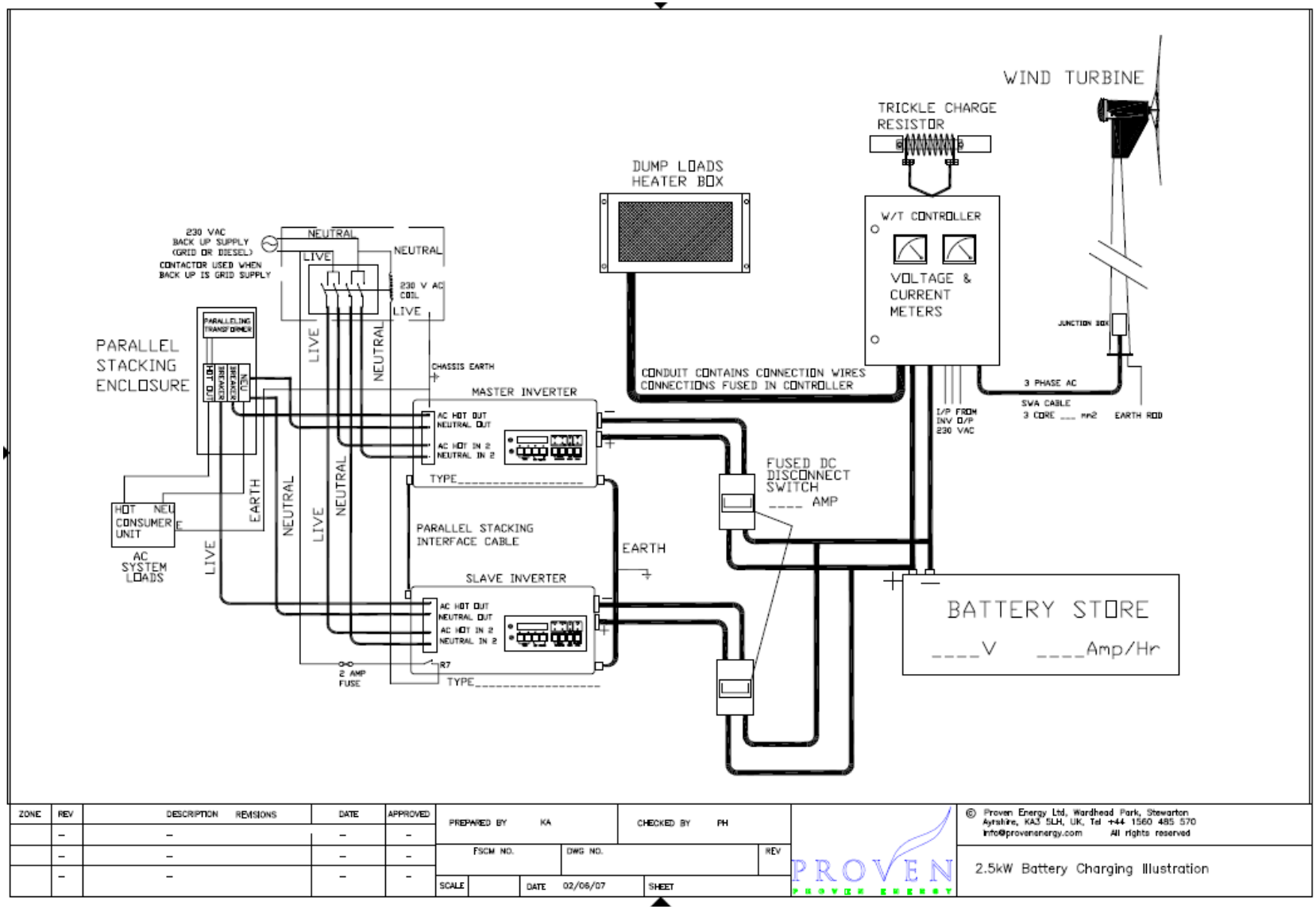
PREPARED BY RC

CHECKED BY

ECM2501 Electrical Schematic
Wind Turbine Battery Charging Controller Diagram

FSCM NO.	DWG NO.	REV
	2500 EE 003A rev 3.dwg	3

SCALE | Date 16/5/03 | SHEET


WIND TURBINE
TRICKLE CHARGE RESISTOR
DUMP LOADS HEATER BOX
W/T CONTROLLER
VOLTAGE & CURRENT METERS
JUNCTION BOX
230 VAC BACK UP SUPPLY (GRID OR DIESEL)
CONTACTOR USED WHEN BACK UP IS GRID SUPPLY
NEUTRAL
LIVE
230 V AC COIL
PARALLEL STACKING ENCLOSURE
CHASSIS EARTH
CONDUIT CONTAINS CONNECTION WIRES
CONNECTIONS FUSED IN CONTROLLER
3 PHASE AC
SWA CABLE
3 CORE ___ mm2
EARTH ROD
I/P FROM INV O/P 230 VAC
MASTER INVERTER
AC HOT OUT
NEUTRAL OUT
AC HOT IN 2
NEUTRAL IN 2
TYPE_____
FUSED DC DISCONNECT SWITCH
____ AMP
HOT NEU
CONSUMER UNIT
AC SYSTEM LOADS
EARTH
PARALLEL STACKING INTERFACE CABLE
SLAVE INVERTER
2 AMP FUSE
R7
BATTERY STORE
____V ____Amp/Hr
ZONE
REV
DESCRIPTION REVISIONS
DATE
APPROVED
PREPARED BY KA
CHECKED BY PH
FSCM NO.
DWG NO.
REV
SCALE
DATE 02/06/07
SHEET
PROVEN
PROVEN ENERGY
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2.5kW Battery Charging Illustration

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	5 mm Allen Key	Yaw Bearing grub screw
1	Pair of Wire Snips	Trimming cover cable ties
1	36mm Spanner (e.g. 36mm socket on ¾" drive ratchet with 1m scaffold tube or similar for extension. 4" to 6" socket extension sometimes useful)	TM650 M20 Tower Bolts TM1100 M24 Tower Bolts (connecting tower onto base plate)
1	Tube of glazing silicon & gun	Cover Sealant
1	Threadlocking Compound e.g. 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	Flat file	Removing any galvanising drips to allow tower fitting with yaw bearing

3.2 Tower Assembly

Proven TM1100 (11m) tower is supplied in two sections whereas the Proven TM650 (6.5m) is single section tower.

3.2.1 Procedure

- Lift parts off vehicle
- The tapered sections need to be fitted together first (see appendix for procedure)
- Take tower sections to foundation
- Fit the bottom section of the tower to the base plate of the foundation using hinge pins provided.

Advice

Ensure the mast is adequately supported to allow safe working on the head

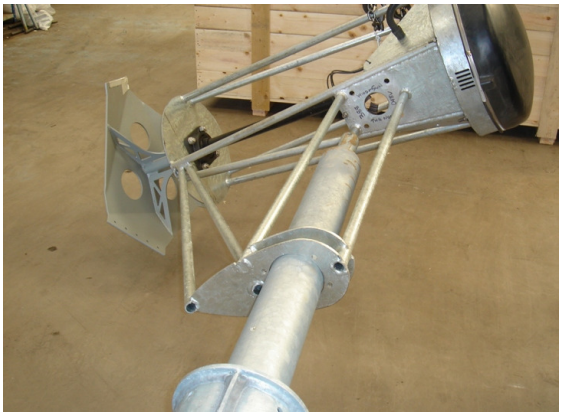
3.3 Fitting the Turbine Head to the Tower Top

3.3.1 Procedure

Note: The down cable and brake rope can be fitted at this stage when fitting the slip ring assembly.

- Prepare tower for fitting with the head

- Carefully slide the turbine head frame onto the tower as shown



- Fit 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.

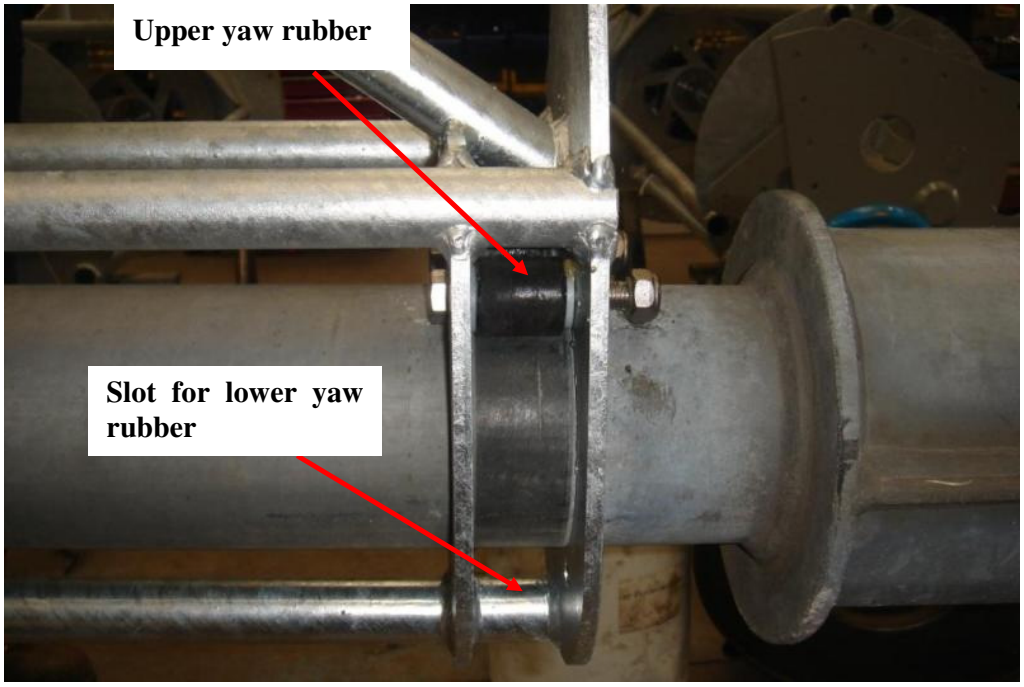
- The yaw bearing fixing bolts (M16) can now be tightened. The turbine head can now rotate around the tower. Withdraw the head assembly back off the tower approximately 50mm, Spread some thread locking compound (loctite A118) onto the spigot and push head fully home. Tighten bearing grub screw using 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 wench

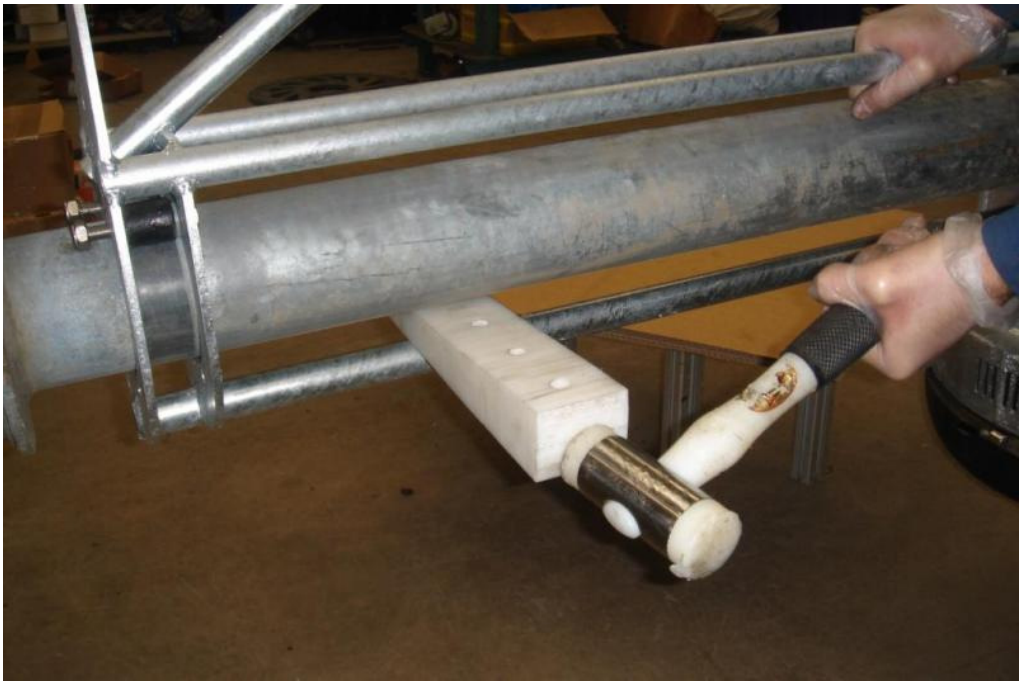
- Prepare yaw rollers and bolts for fixing by greasing the bolts and rubber ends.

Greased yaw rubbers & fixings

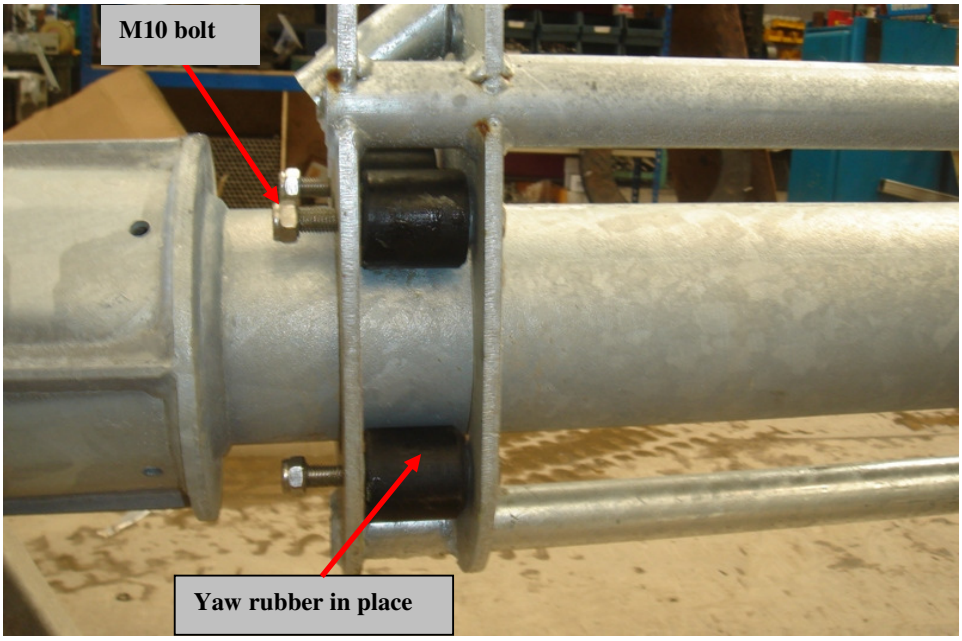
- **Fit the two upper yaw rubbers first.** Slot bolt through yaw frame hole as shown below, and guide it through the rubber and nylon washer and through the lower frame hole.



- Using a plastic or wooden wedge pry up the frame to make it easy to fit the two lower yaw rubbers.



- Tighten the yaw rubber bolts using a 17mm ratchet and spanner. Do not overtighten the rubbers so that they can rotate.



- Check everything is tight and that the turbine will freely rotate within its yaw axis.

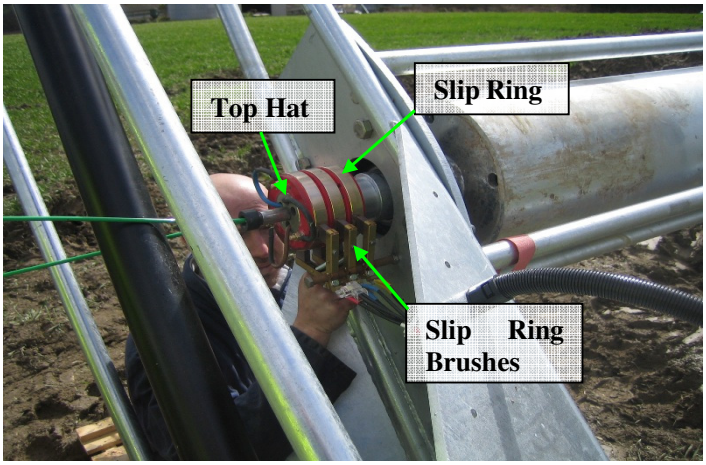
- Finally spin the rotor by hand to check that nothing rubs. If the turbine has been roughly handled then the domed generator cover can get pushed against the magnet plates. If this is the case gently tap the cover back into position and reseal if necessary with silicone.

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:

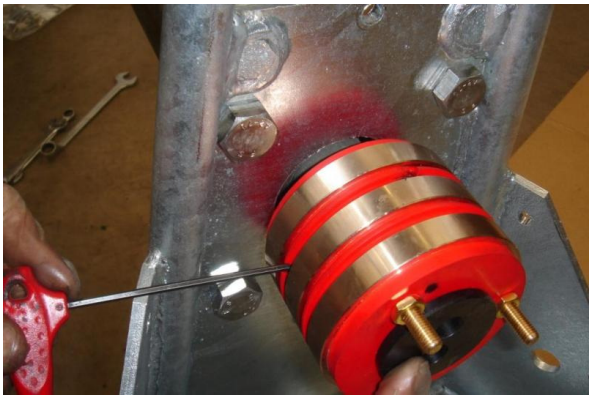
1. Slip ring (3-ring) with 2 grub screws
2. Mount stand for slip ring brushes
3. Slip ring brushes for each ring



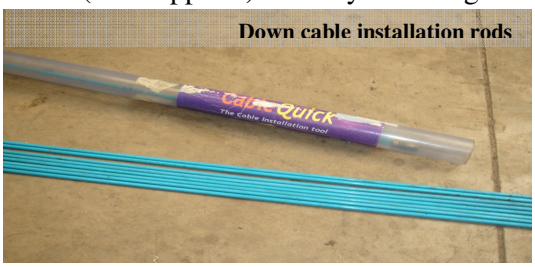
3.4.2 Procedure

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

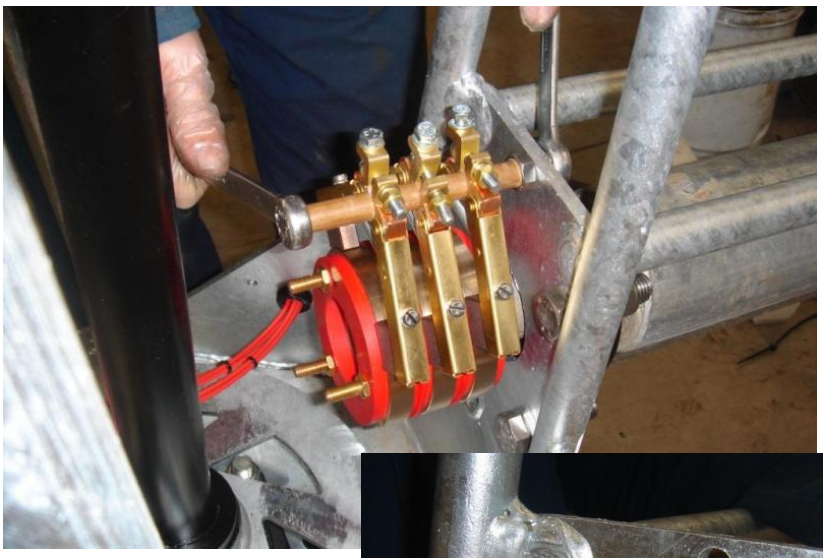
- If cable is fitted at this stage then feed cable through the slip ring and top hat. If not the fit slip ring onto spigot, fit top hat into the end of slip ring so that it butts up against the end of the tower top. This is the position the slip ring should be secured in. Slide back the slip ring and 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.

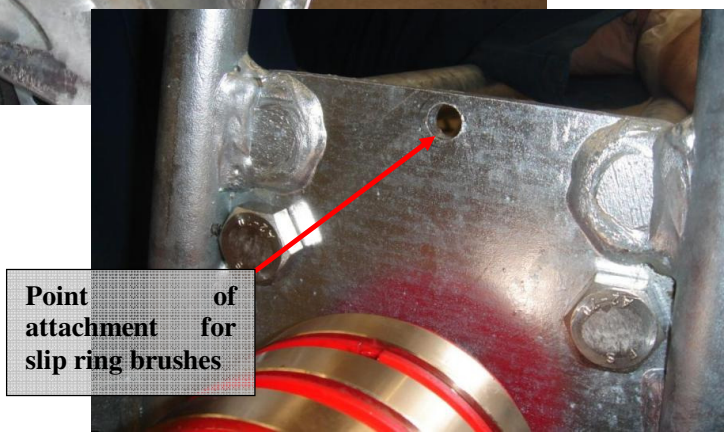


- Assemble down cable installation rods (not supplied) so they are long enough to match tower height. Alternatively a draw string or other suitable methods can be used to pull cable down from the top of tower to the bottom.



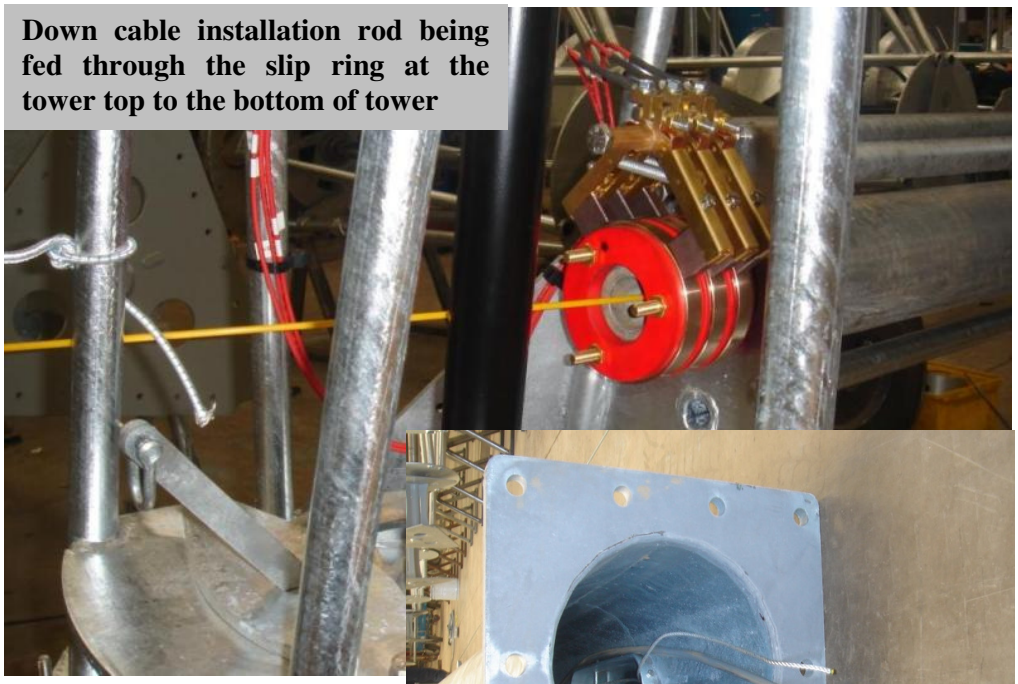
- Now using two 17mm spanners attach the slip ring brushes to the turbine frame. Again be careful not to over tighten as the insulation tube could split.





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

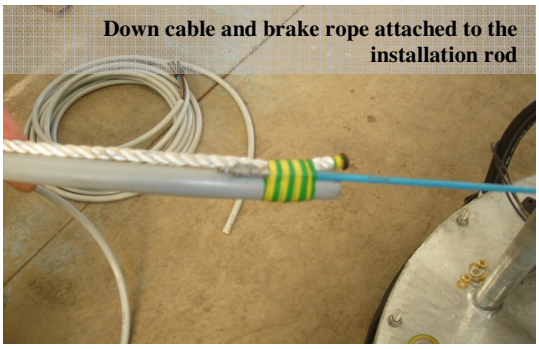
Down cable installation rod being fed through the slip ring at the tower top to the bottom of tower



Down cable and brake rope at the bottom of tower

- With a 10mm spanner 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.

- Using an adhesive tape, attach the brake rope and down cable (power 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 (secure down cable above top hat with cable ties) 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

Advice

Tie the end of the down cable with a cable tie to prevent it slipping through the hole.

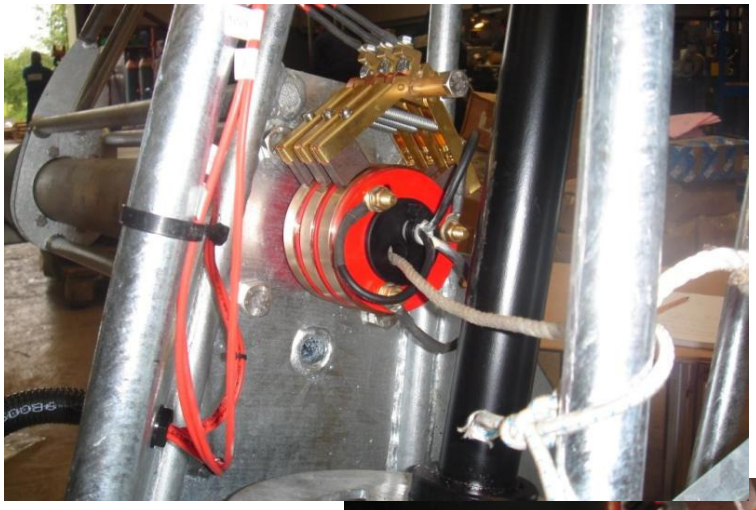
- Now fit the top hat to the slip ring.

Slip Ring Connections:

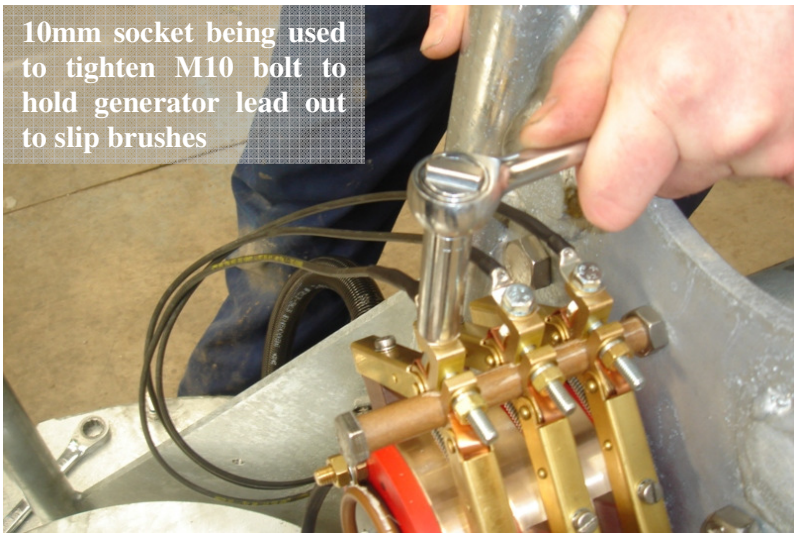
This assumes brake rope and cable are in position and are fitted through top hat assembly

.

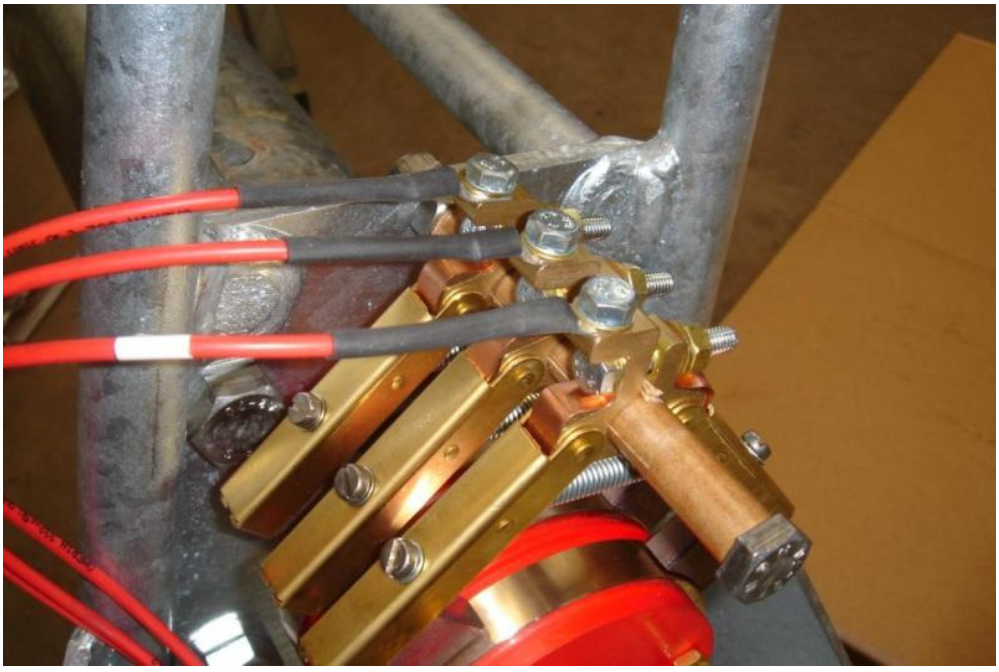
- Loosen the 3 stud nuts on top of the slip ring unit and connect the down cable ends at the top hat to the 3 studs. Tighten the stud nuts with a 13mm spanner. Do not over tighten as you may shear the copper stud. Vibration washers are included to ensure a secure fit. Note any cable can be connected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



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



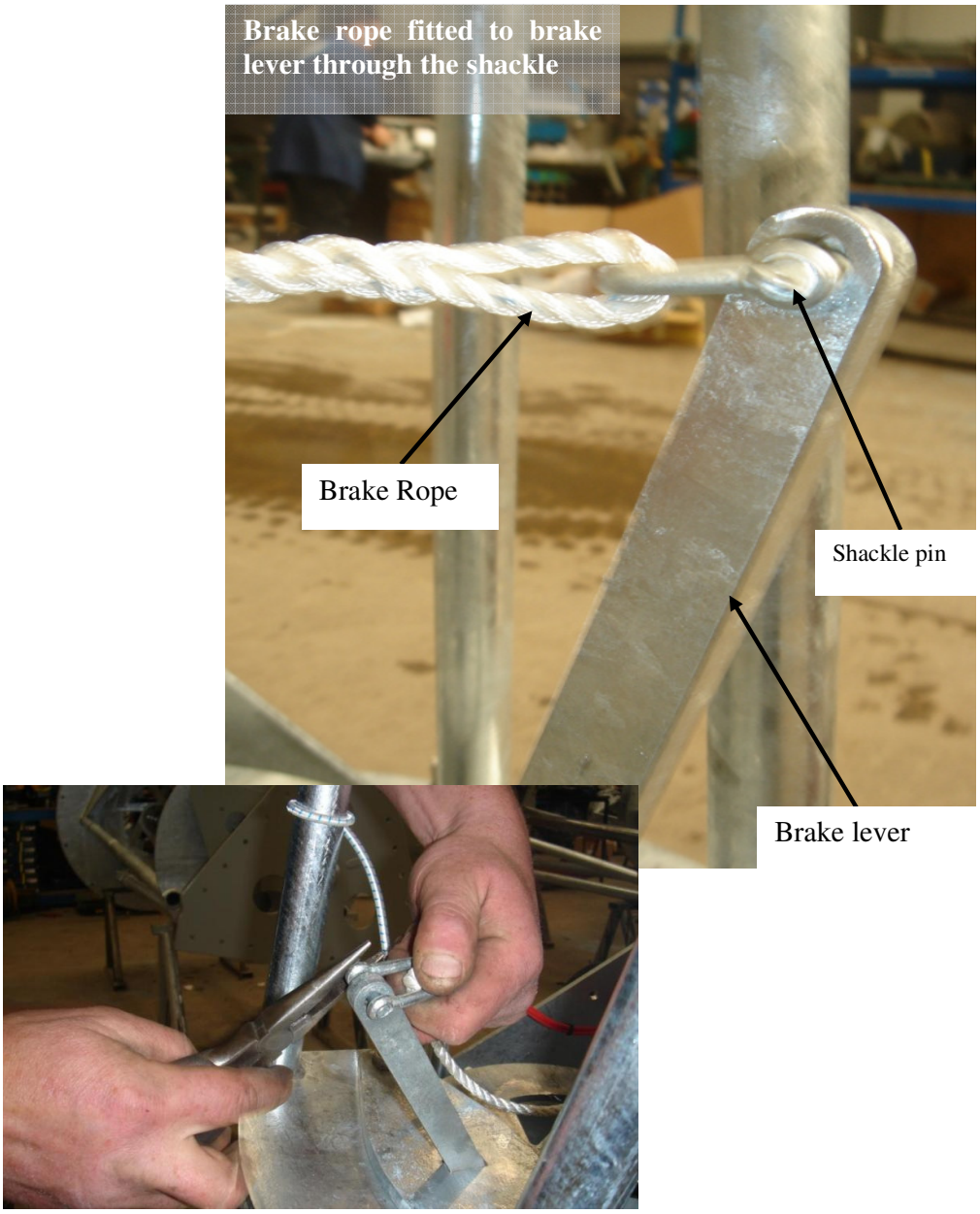
10mm socket being used to tighten M10 bolt to hold generator lead out to slip brushes



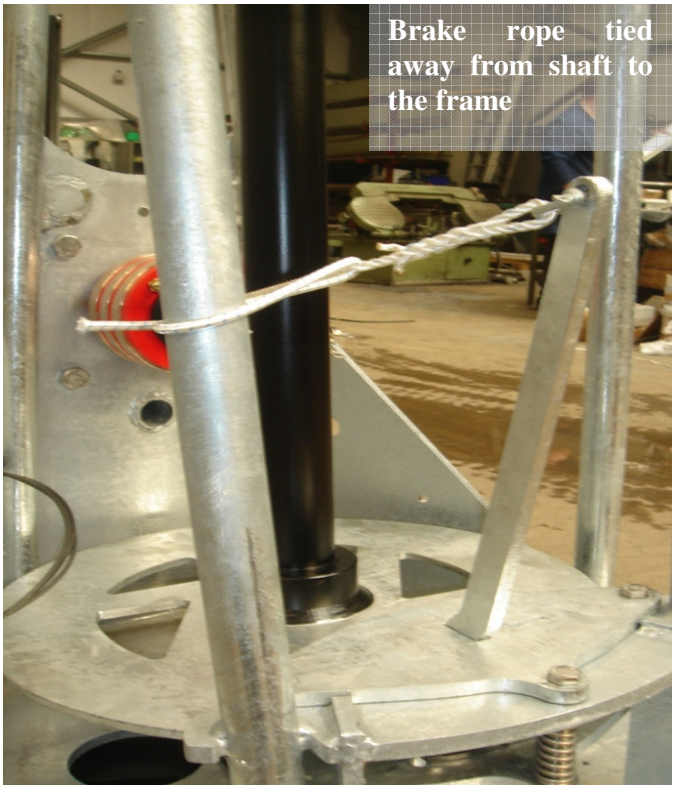
3.5 Brake Rope Installations

3.5.1 Procedure

- Attach the end of the brake rope that comes out through the top hat to the shackle of the brake lever and tighten using a plier.



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



3.5.2 Brake Lever Installation Procedure

The brake is activated using the brake lever. The brake lever is installed by opening the tower door using the tower door key supplied.

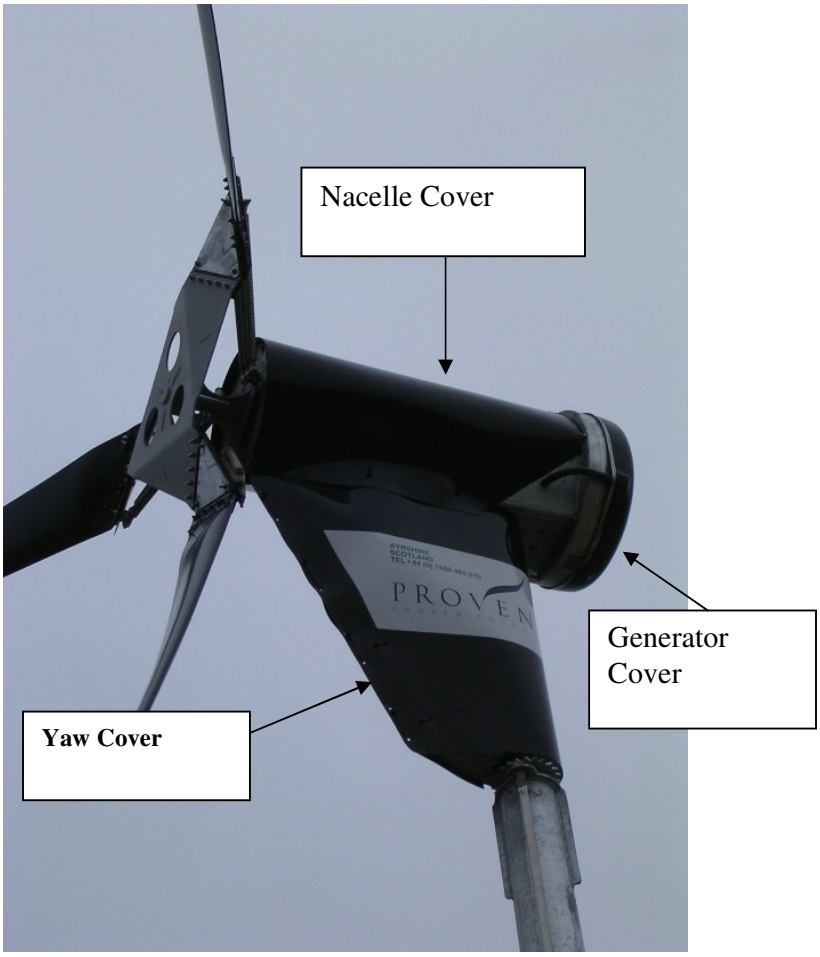
- Turn brake lever assembly such that it acts as an overcentre lever (i.e. welded bolt on handle closest to back of tower).
- Bolt the brake lever assembly using the two M6 bolts supplied, remembering to use threadlocking compound (loctite) on bolts.

3.6 Fitting the Covers

The turbine is supplied with the following covers:

1. Generator cover
2. Yaw cover
3. Nacelle cover (or the rotor shaft cover)

The covers are made from black or black U.V. stabilised polypropylene plastic. They are fitted to the wind turbine frame using cable ties.



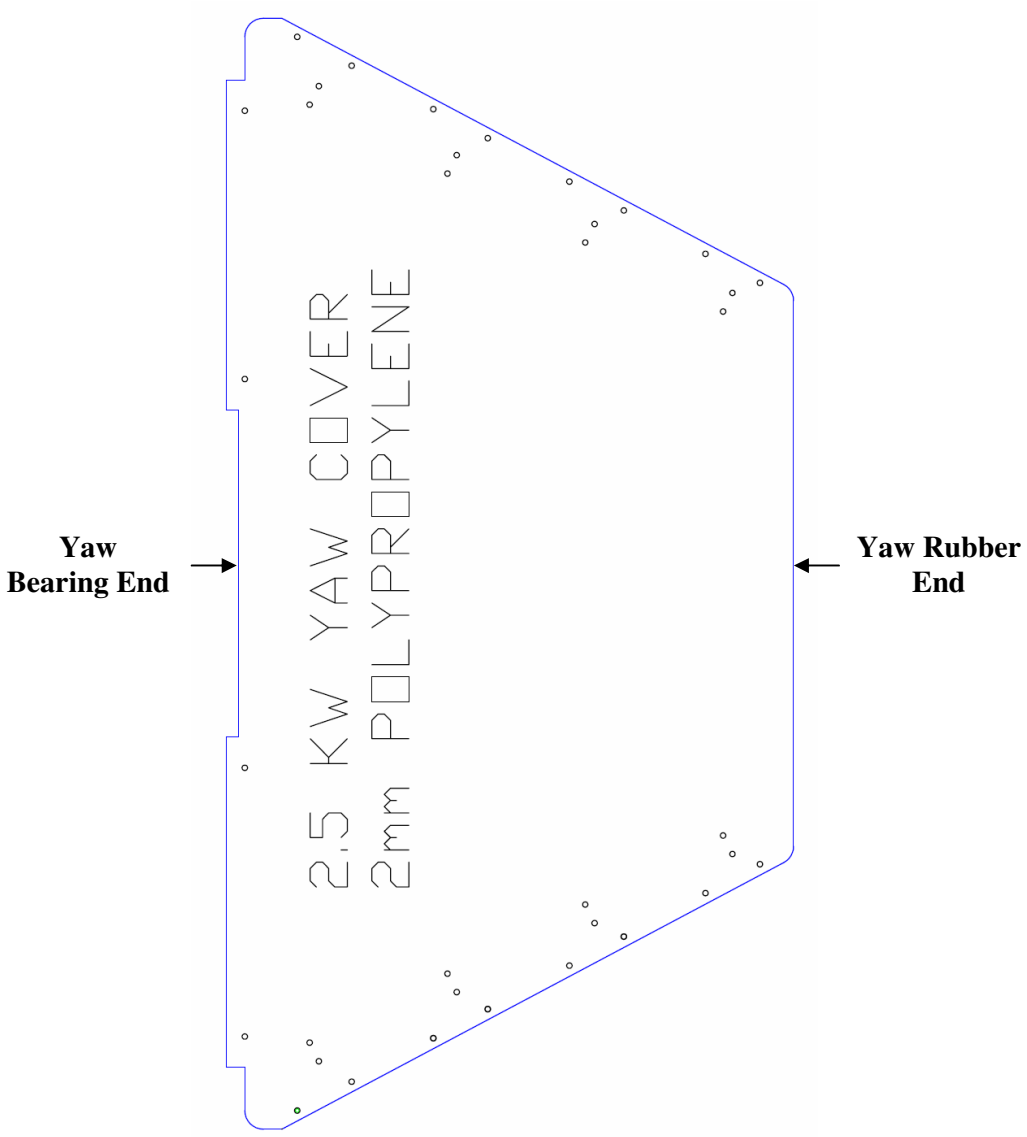
The yaw cover is fitted **first!**

3.6.1 Fitting the Generator Cover

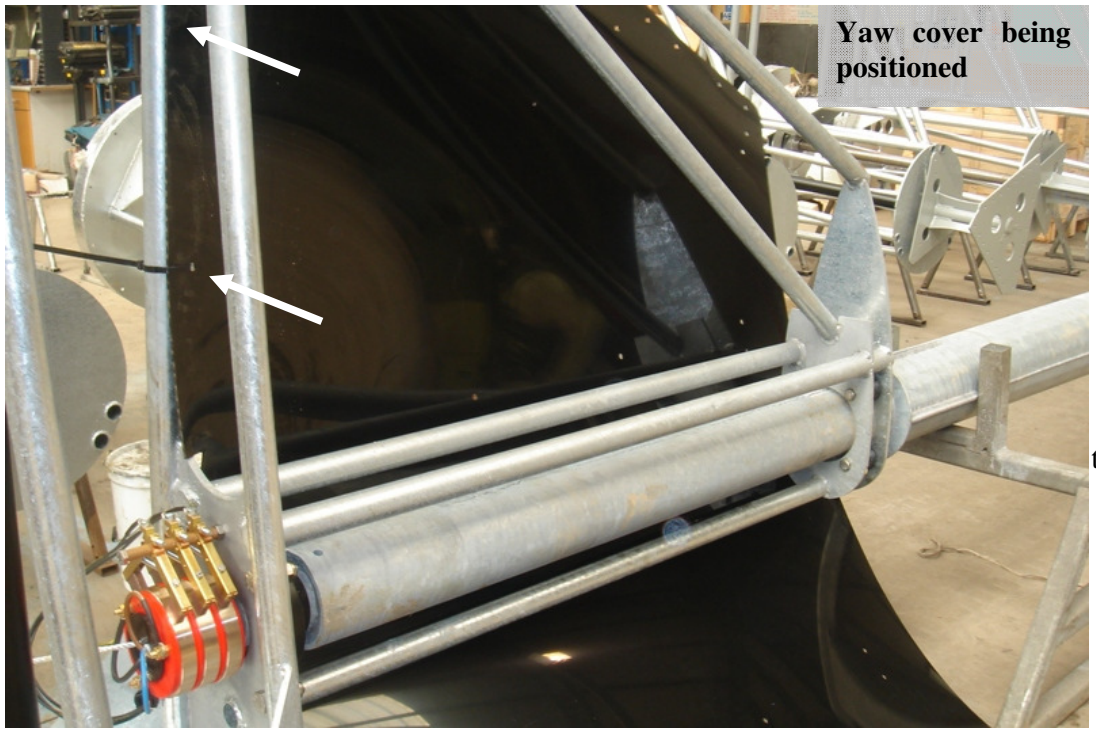
The generator cover is secured over the electrical generator by means of an SS “Jubilee clip”. The generator is supplied with the cover already fitted.

3.6.2 Fitting the Yaw Cover

Procedure



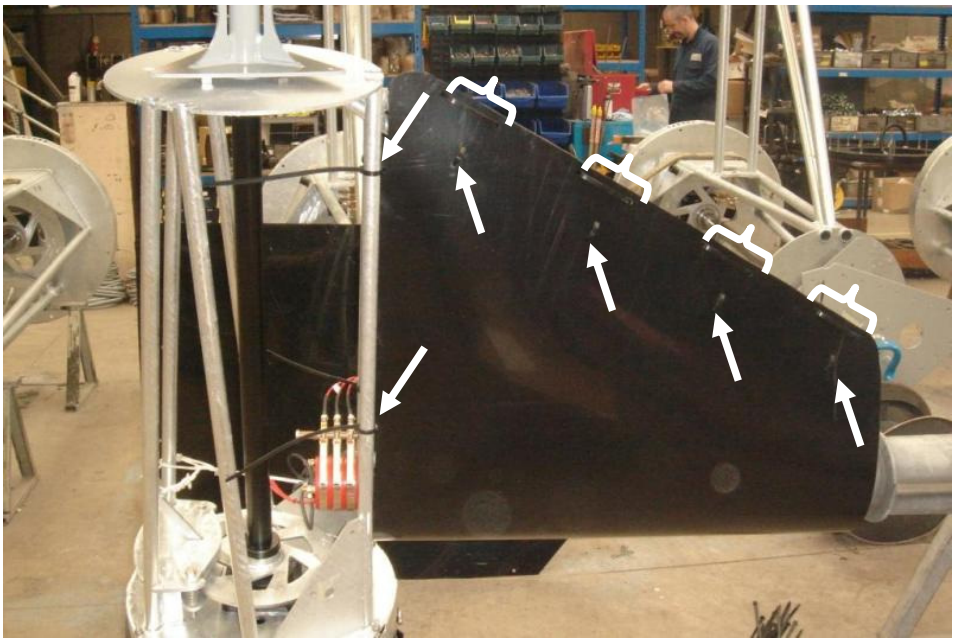
STEP 1: Offer up yaw cover to the frame and attach (see arrows shown below) using the cable ties. Feed cable tie from front through cover around the steel bar and back through the other hole, secure tie but **do not** fully tighten until all ties have been fitted.



Yaw cover being positioned

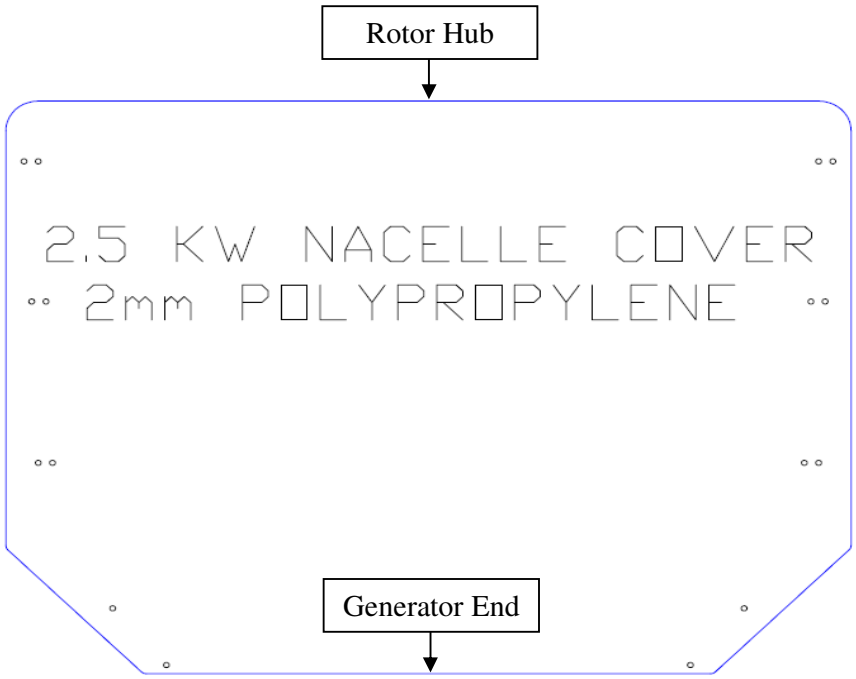
to the

STEP 2: Fold the cover around the frame under the generator end and secure the cover to the frame using cable tie (see arrows below) as in step 1.



STEP 3: Finally tighten all ties and trim

3.6.3 Fitting the Nacelle Cover



Procedure

STEP 1: Fold the cover over and around the nacelle frame and secure with cable ties. It may be necessary to join cable ties together to get the required length. Tighten all cable ties and trim.

3.7 Blades Assembly

Caution!

- Treat the blades with exceptional care – especially the leading and trailing edges of the airfoil.
- The blades are supplied as a balanced and matched set of three. Ensure each balanced set is keep and used together at all times.

3.7.1 Blade Description

The blades are made of the following parts

1. Airfoil – polypropylene
2. Zebedee hinge at blade root – polyurethane (PU)
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.

3.7.2 Fitting the Blades

Procedure

- Put polyprop (plastic) washer on top of hub (NB. back end of hub)
- 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 Threadlock (e.g. Loctite, Permabond A118 or similar) to lubricate **and** secure fixings against vibration. Use only a **small** amount on each bolt.

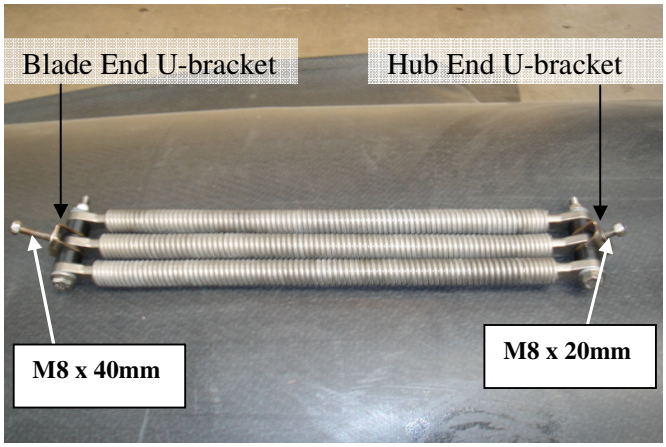
3.8 Zebedee Spring Assembly

3.8.1 Description

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

1. Three (3) individual springs.
2. U-bracket with M8 x 20mm bolt for connection to spring hub plate.
3. U-bracket with M8 x 40mm bolt for connection to blade root.

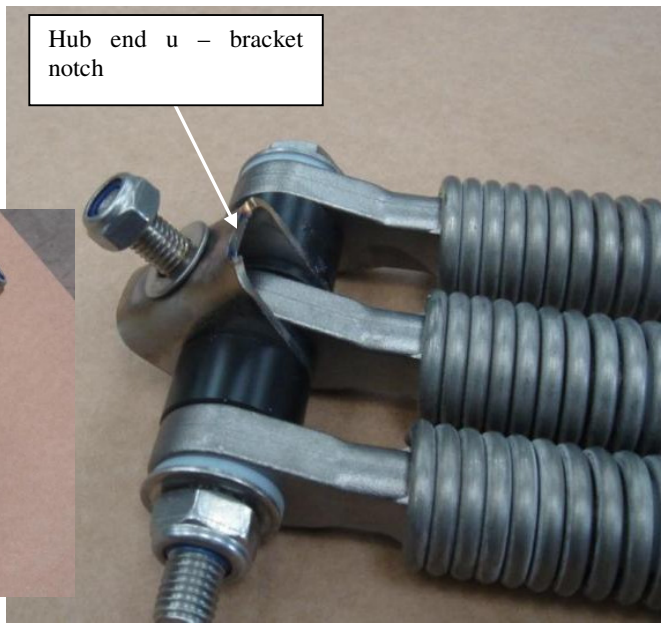
These three items are supplied already fitted together.

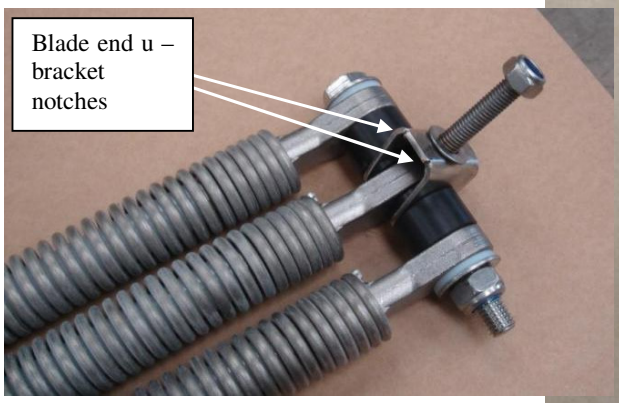


Fitting the Zebedee Spring Assembly

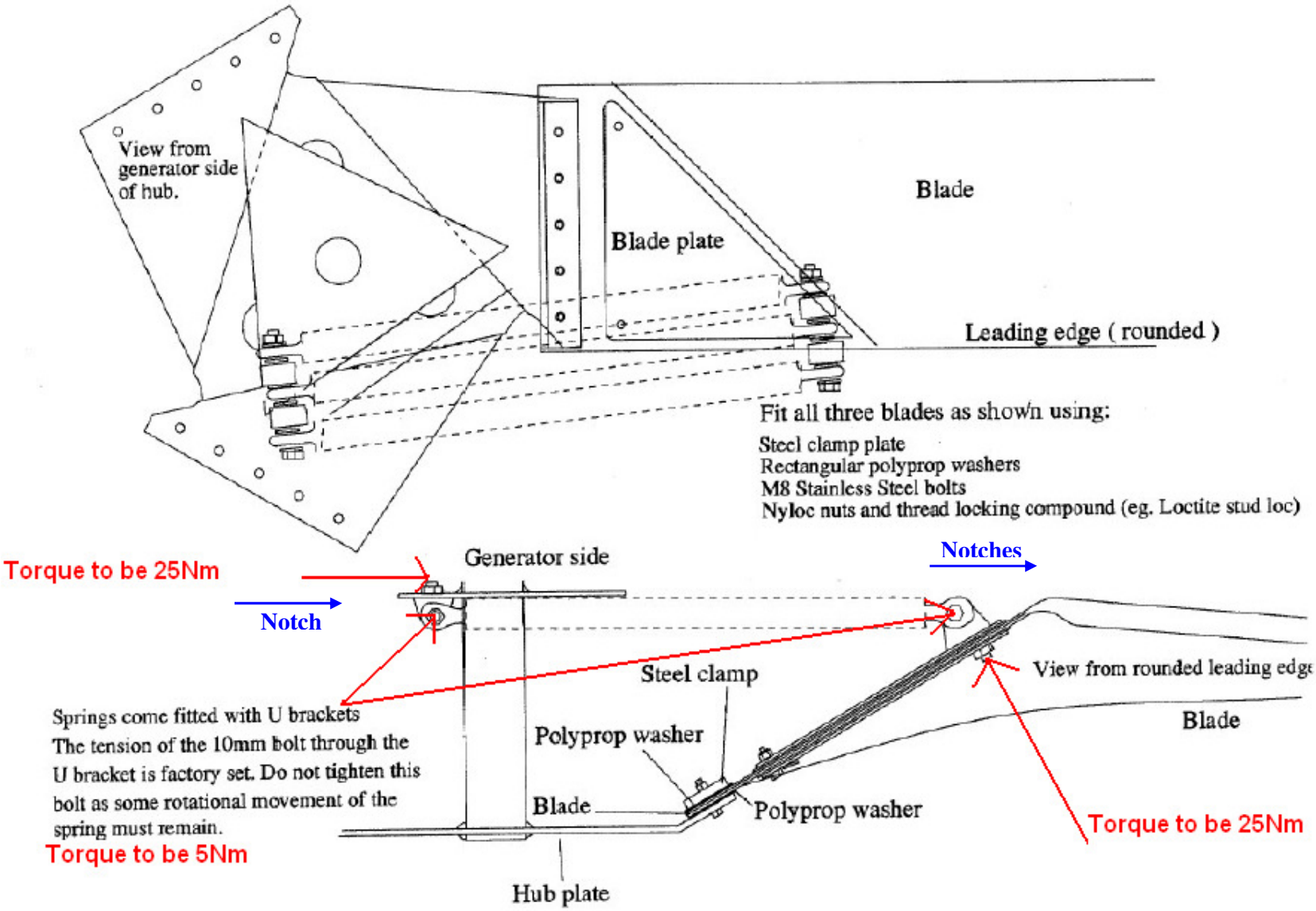
2.8.2 Procedure

- Bolt the U-brackets to the spring hub plate and blade roots respectively via the U-bracket retaining bolts fitted. Ensure the notches on both U – brackets are turned to face the tip of the blades.





- It is **very** important that the M8 fixing bolts running through the spring ends are not fully tightened as they are already factory tightened. This allows the spring ends to freely rotate during normal operation. However, there should be no lateral movement of the spring ends within the spring bracket.
- Check to ensure that all fasteners are tight (25Nm for hub end and blade end u – bracket bolts).
- Repeat for the remaining set of springs.



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3.9 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.

3.10 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.

3.11 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 0-300 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.

4.0 Wind Turbine Maintenance

Your PROVEN 2.5, like all Proven Energy turbine models, require minimal maintenance. We recommend an annual service and regular visual inspection to spot any unusual occurrence.

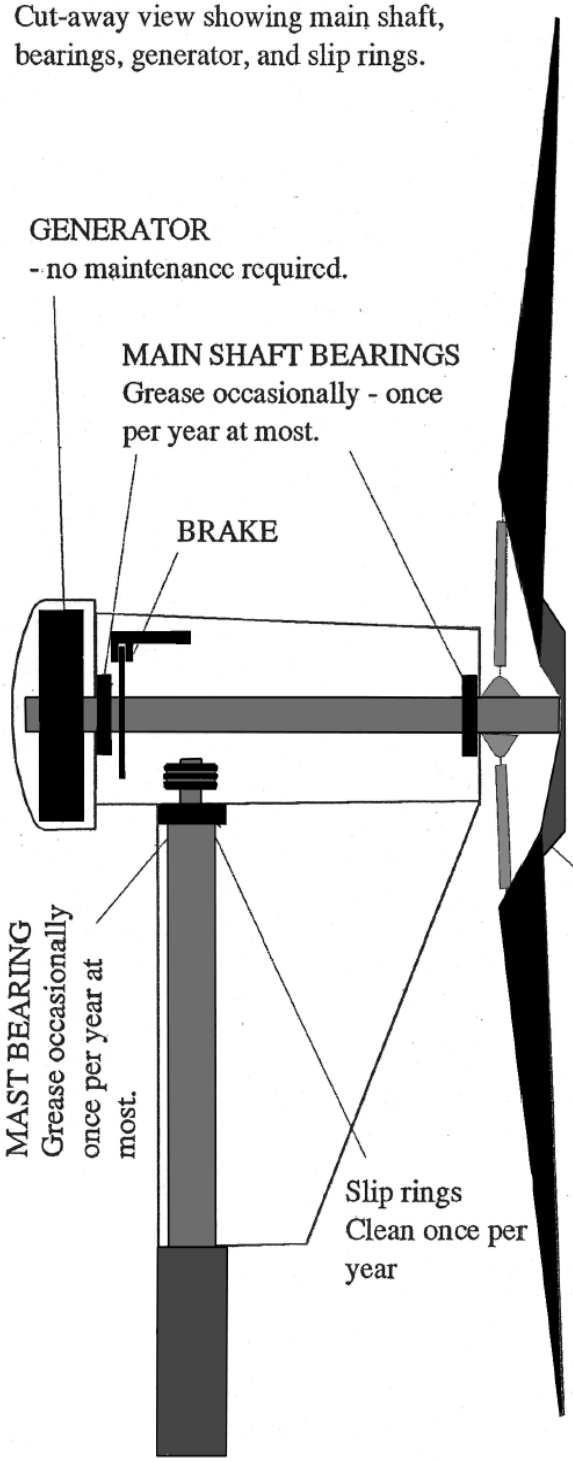
Caution!
Any damaged or cracked blade should be repaired or replaced immediately.

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. 1 or 2 pops is recommended.
- Clean slip-ring assembly with emery cloth
- Check flange bolts and tower base bolts for tightness
- Listen for any abnormal noises or excessive vibrations, if any exists 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.

PROVEN WT2500 2.5KW WIND TURBINE

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

PROVEN
PROVEN ENERGY
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4.2 Wind Turbine Maintenance Schedule

TASK	TYPE OF SERVICE CHECK			
	INITIAL 3 MONTHS	QUARTERLY	ANNUALLY	10 YEARS AFTER
Check for smooth running	√	√	√	√
Check tower bolts	√	√	√	√
Check ph-ph voltage	√	-	√	√
Check brake operation	√	-	√	√
Check blades	√	-	√	√
Clean slip rings	-	-	√	√
Check slip ring brushes	-	-	√	√
Grease shaft bearings	-	-	√	√
Check yaw rubbers			√	√
Grease yaw rubber bolts			√	√
Grease yaw bearing	-	-	√	√
Check covers	-	-	√	√
Check welds	-	-	√	√
Change springs	-	-	√	√
Change blades	-	-	-	√

4.3 Maintenance Check List

KEY:

- X = Check
- G = Grease
- A = Adjust if need be
- C = Clean
- R = Replace 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	X		
32 BATTERY ELECTROLYTE	X		
COVERS & OTHER CHECKS			
33 GENERATOR COVER CONDITION	X		
34 YAW COVER CONDITION	X		
35 NACELLE COVER CONDITION	X		
36 CABLE TIES	X	R	
37 YAW RUBBERS	X	G	

4.4 Recommended Spares

- PU2501 Set (3) of Turbine Blades with PU Hinge & Fixings
- YRO2501 Set (4) of Yaw Rubbers with Fixings
- ZBT2501 Set (3) of Zebedee Springs with Fixings
- BRK2501 Set (2) of Brake Pads
- SLR2501 Slip Ring with Brushes and Fixings

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	- Tighten loose fittings or components
Turbine fails to turn in good wind	- Shorted cables - Shorted diodes - Failed bearings -Foreign object in generator	- Check connections	- Repair short circuit - Replace faulty diodes - Replace bearings - Remove obstruction
Turbine turns slowly in good wind	- Partial short in cables - Diode short	- Check connections	- Repair short circuit - Replace diode
Low output	-Low wind speeds -Obstructions around turbine -High power usage	- Measure wind speed - Check siting of turbine - Check power usage	- Site turbine in a better location or height - Economise power use
Turbine vibrates excessively	-Blades incorrectly fitted or out of balance -Yaw bearing worn	- Check blade fittings	- Fix blade properly and balanced - Replace yaw bearing
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

6.0 Operation

Once installed and commissioned the Proven 2.5 (WT2500) operates automatically. Power output will vary with wind speed according to the power curve.

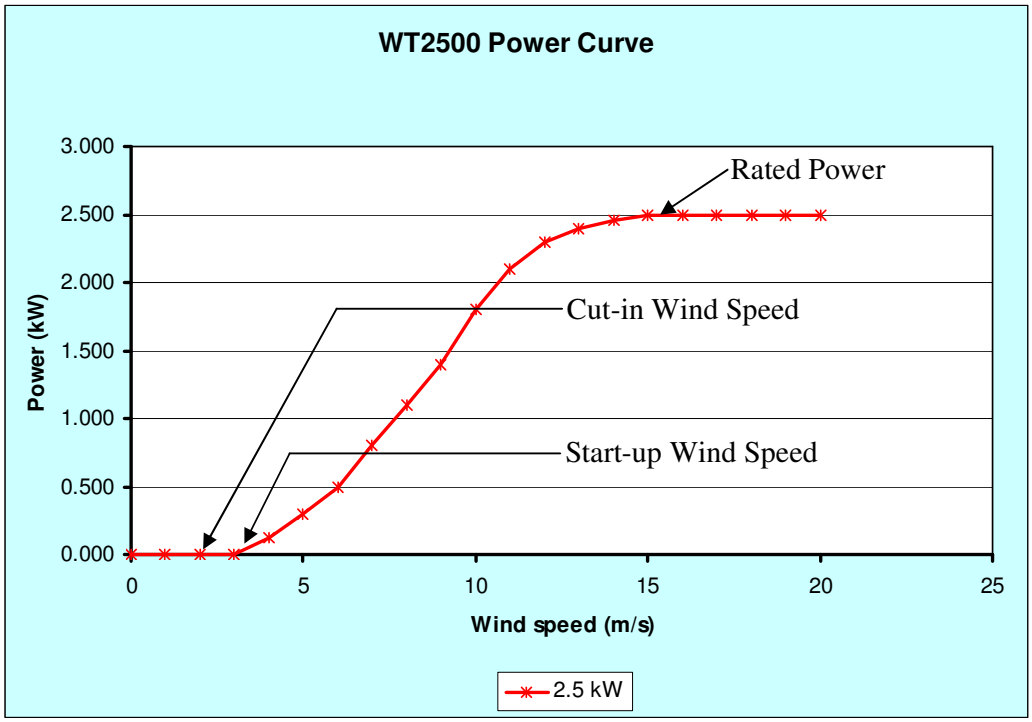
6.1 Power Curve

The power Curve is a graph that illustrates how the power output of the wind turbine varies with wind speeds. The power curve has been developed from collating a number of data logs obtained through standard testing procedures for a year.

Cut-in Wind Speed: Is that wind speed at which the wind transfers enough force to turn the rotor blades.

Start-up Wind Speed: Is that wind at which the turbine just begins to produce power. At start-up, the rotor blades turn fast enough and have adequate torque to enable the generation of power.

Although cut-in and start-up wind speeds are fairly close, they should not be mistaken to be the same.



Rated Wind Speed: Is the wind speed at which the turbine attains rated power. That occurs around 12m/s for a WT2500 and therefore ideally the power output should be 2.5 kW.

Rated Power: Is the optimum power output of the wind turbine which is 2.5 kW for the WT2500.

The Zebedee furl mechanism in place ensures that the output is regulated to the rated output at wind speeds above the rated wind speed.

The power output from the turbine can be determined from the meters installed. This is done by multiplying the instantaneous voltage reading in Volts on the voltmeter and the instantaneous current reading in Amperes on the ammeter to obtain the instantaneous power in Watt. Note that 1 kilowatt (kW) = 1000 Watt (W).

6.2 Vibration

The turbine should run smoothly at all wind speeds. Any significant vibration of the turbine and tower assembly should be reported to Proven Energy and the turbine stopped.

6.3 Noise

Virtually every device with a moving part makes noise and turbines are no exception. The turbine noise is produced by swishing sound from the blades as they rotate in the wind and is generally proportional to the wind speed and turbulence level. Noise is measured in decibels (dB). The noise the wind turbine creates is expressed in terms of sound power level which is a measurement of the noise power emitted by the turbine.

Proven Wind turbines have low noise levels because they have no gearboxes which are a major source of turbine noise. For example at 5m/s the emitted noise level is 45 dB (A) which lower than that of a car passing 20m away at a speed of 40mph (70 – 80 dB (A)). It is therefore perfectly normal to stand underneath the turbine and practically have a conversation without shouting. At the rated speed however i.e. the speed where the blades cone in to limit power output to rated, the noise level will increase slightly.

Other than that any non-air noise should be reported to Proven Energy.

6.4 Stopping the Turbine

Due Care & Attention Required

Due to the nature of the brake assembly on this type of turbine we recommend the use of rigger gloves when operating the lever.

Please note there is no risk of serious injury, only a small risk of finger entrapment if the lever is not used as directed below.

1. Using key supplied remove tower access door.
2. Check location of the over centre lever. This lever needs to be in the 12 O'clock (start) position. If you need to move the lever into this position then gently push to the right hand side as you move the lever up into start position. **Be careful not to trap hand between these parts as you move them.**
3. Place knot on brake rope over the welded bolt on the brake lever.
4. Firmly pull down lever, brake will start to engage as lever arcs downwards. Push firmly into back of lever assembly, lever now in 6 O'clock position.
5. Re-fit tower door and tighten bolts with key.

7.0 Appendices

Appendix A: Product Warranty

Appendix B: Lifting Equipment Instruction Sheets

Appendix C: Tower Assembly and Erection Procedure

Appendix D: Torque Settings

Appendix A

Product Warranty

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.

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.

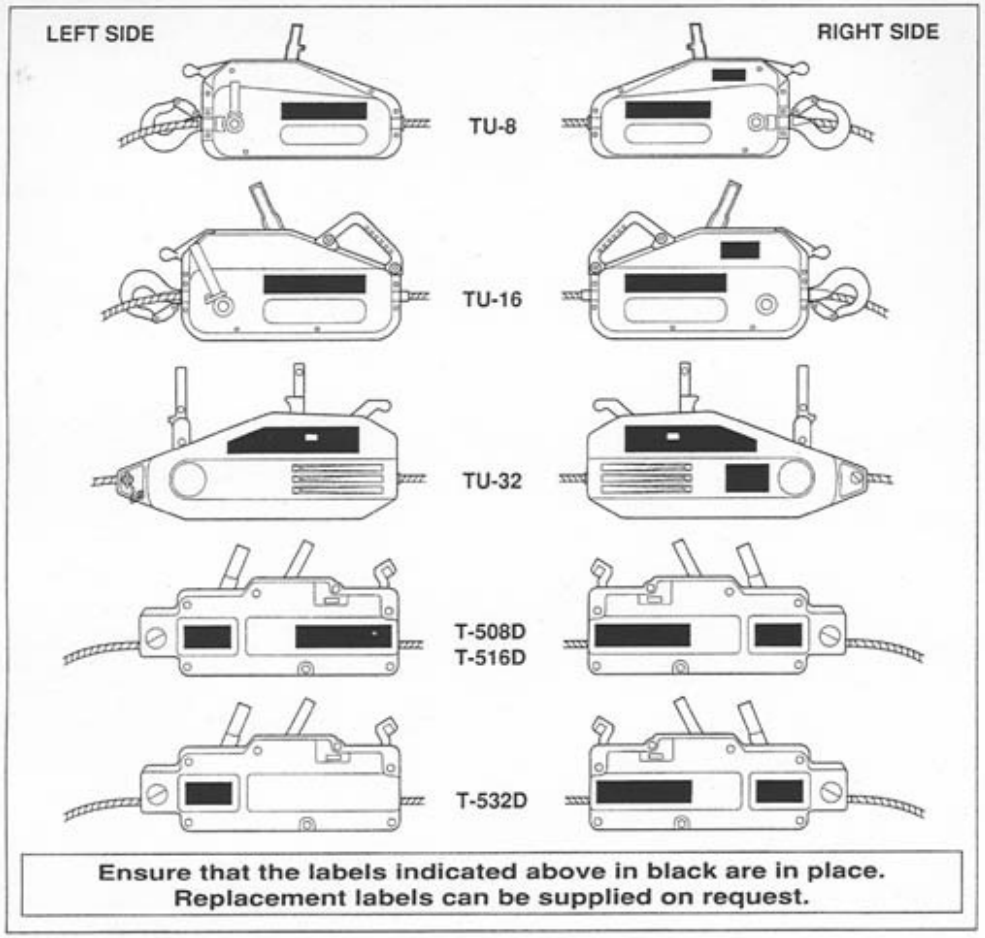
Actions in the Event of a Defect Occurring During Warranty Period: In the unlikely event of a defect arising, first ensure the safety of people and equipment by electrical disconnection and application of the wind turbine brake, as appropriate. Please notify the Proven Service Department, or the Proven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

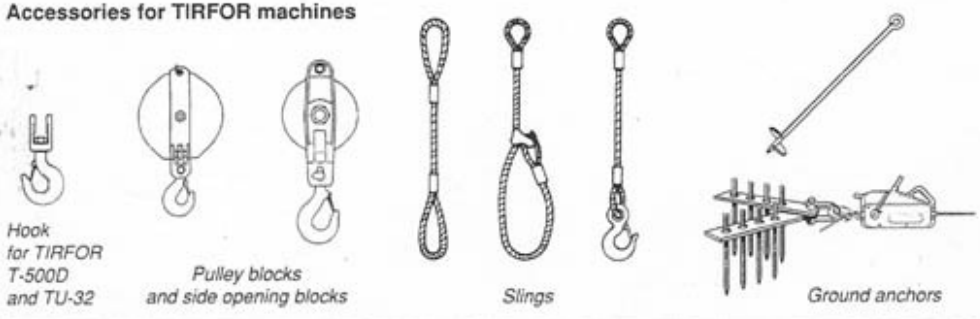
Appendix B

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

008608626 - ind 01 - 09/2001

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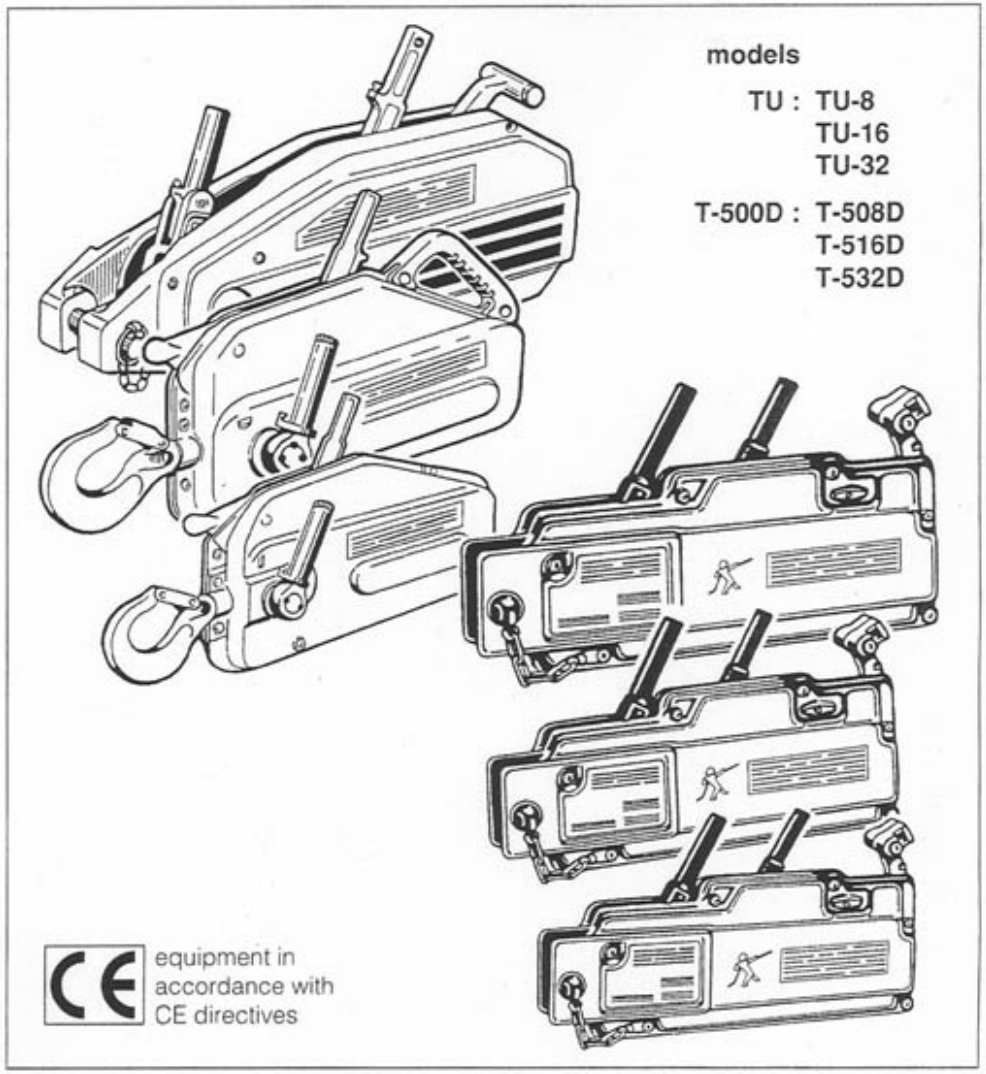
Fax (352) 43 42 42-200
ISO 9001

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

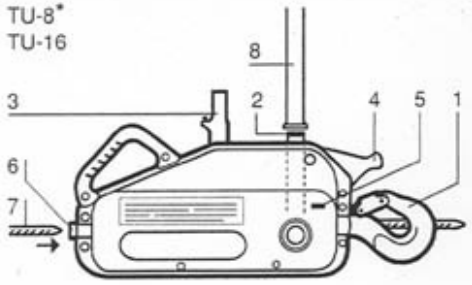
CONTENTS **Page**

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.

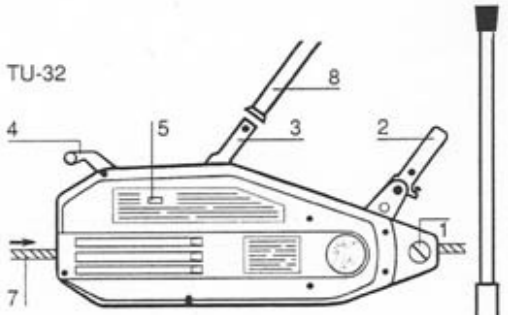
Fig. 1

TU-8*
TU-16

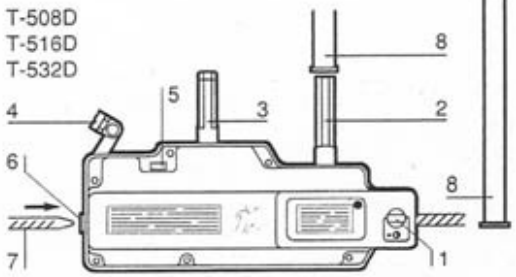


* without carrying handle

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).

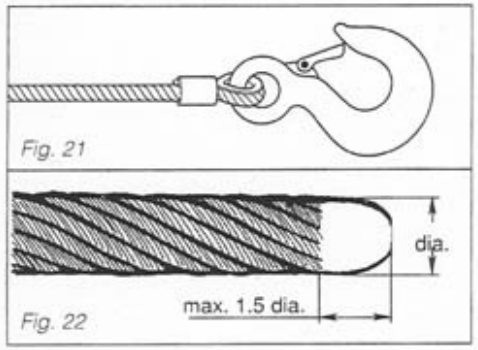


Fig. 21
Fig. 22

⚠ **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).

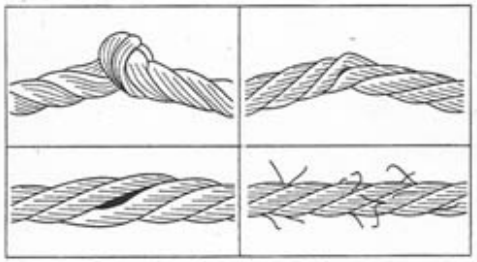


Fig. 23 - Examples of damaged wire rope

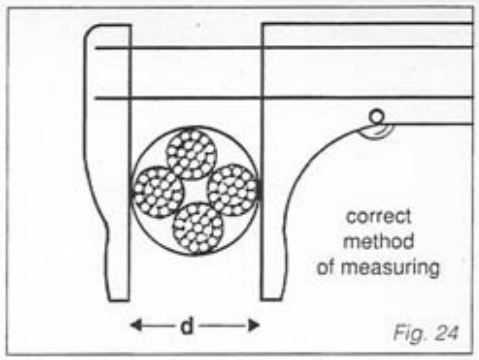


Fig. 24

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.

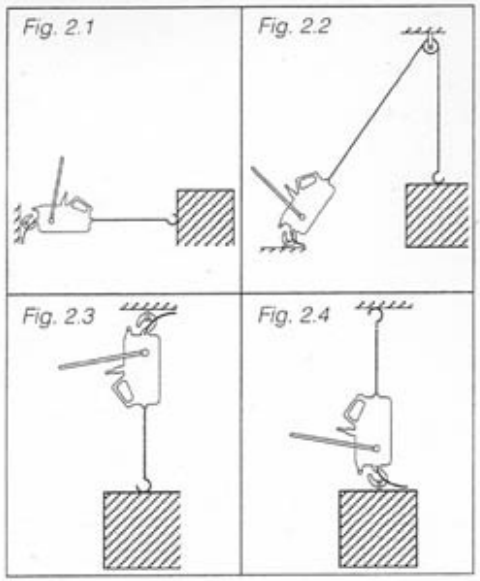
IMPORTANT : TIRFOR MAXIFLEX wire rope has been specially designed to meet the particular requirements of the TIRFOR machine. The manufacturer does not guarantee the safe operation of machines used with wire rope other than TIRFOR MAXIFLEX wire rope.

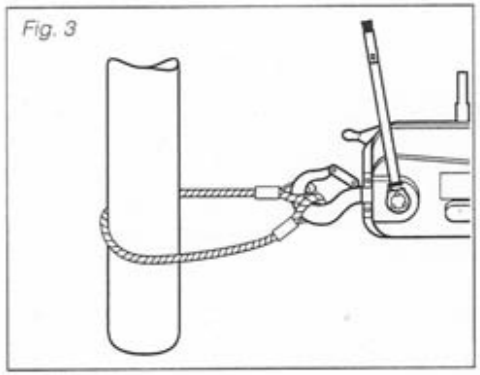
2. RIGGING ARRANGEMENTS

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.**

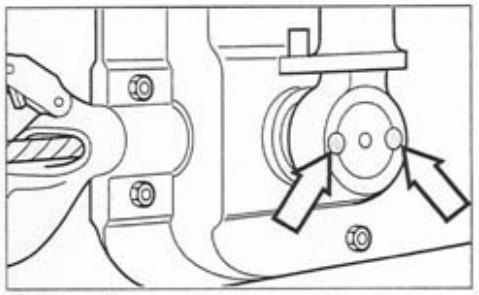


Fig. 17 - TU-8

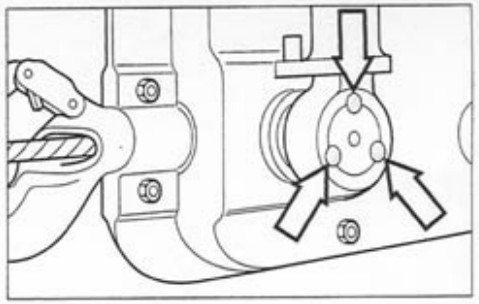


Fig. 18 - TU-16

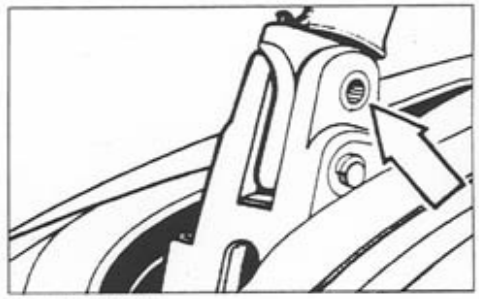


Fig. 19 - TU-32

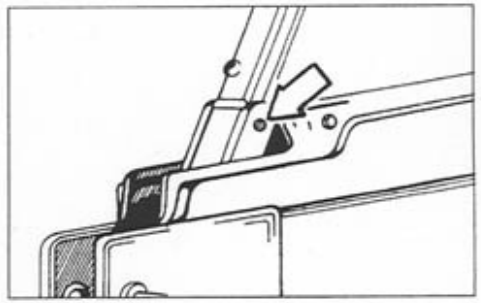


Fig. 20 - T-500D

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.

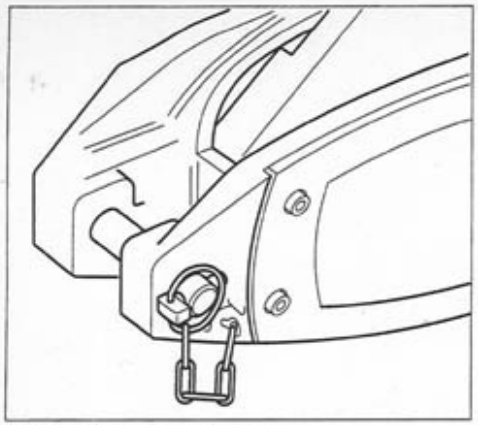


Fig. 13 - Anchor pin in position.

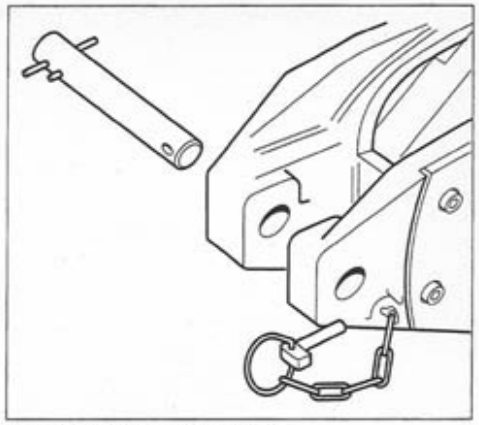


Fig. 14 - Anchor pin removed.

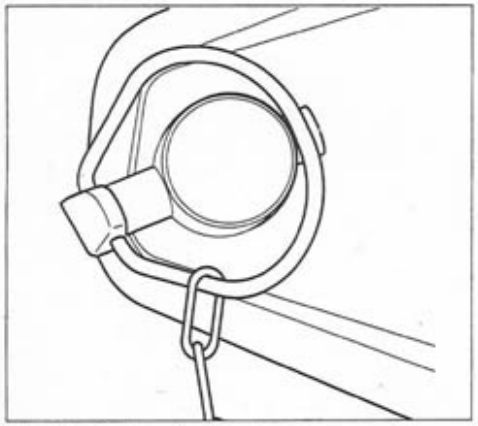


Fig. 15 - Spring clip closed.

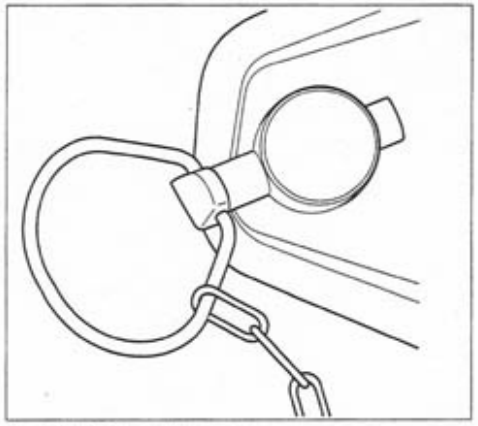


Fig. 16 - Spring clip open.

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

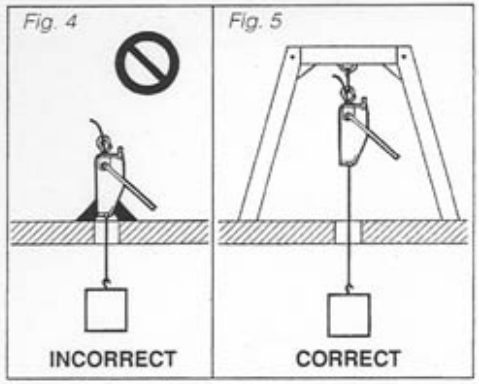
It is essential to take the load off the machine before attempting to release the jaws. To do this, operate the reverse operating lever until there is no tension in the wire rope.

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.

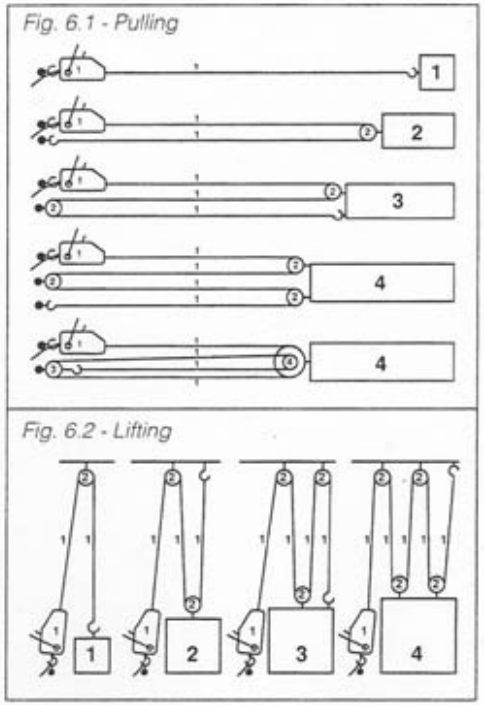
Before reeling the wire rope, it is recommended to inspect it, clean it with a brush and then grease it. (See section 10).



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.



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.

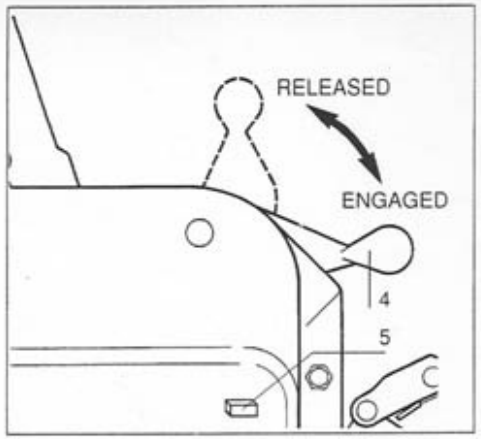


Fig. 7 - TU-8 and TU-16. Rope release lever.

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.

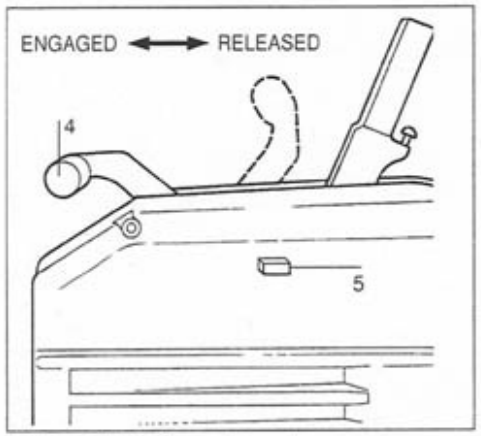


FIG. 8 - TU-32. Rope release lever.

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.

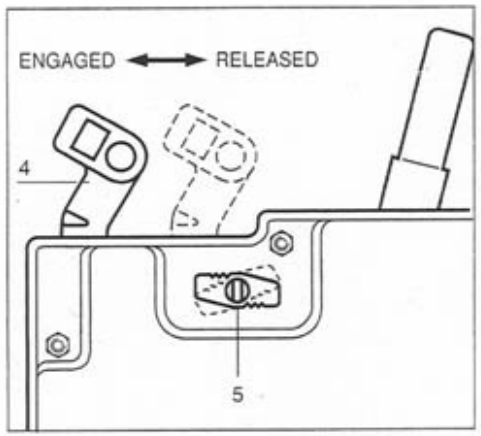


Fig. 9 - T500D range. Rope release lever

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).

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).

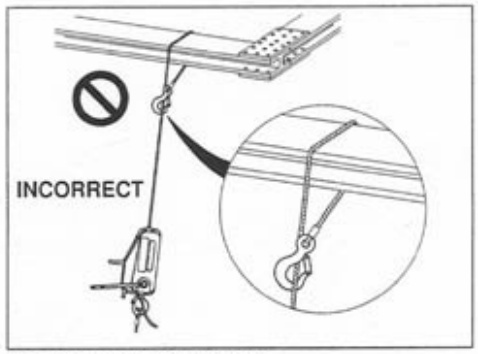


Fig. 10 - Incorrect slinging.

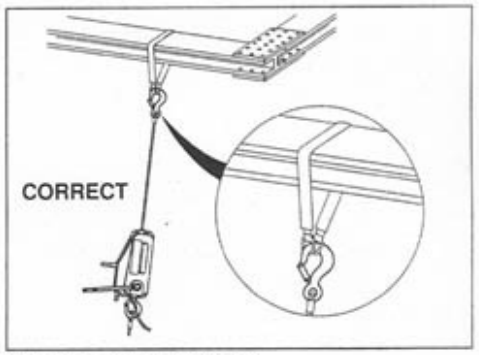


Fig. 10a - Correct slinging.

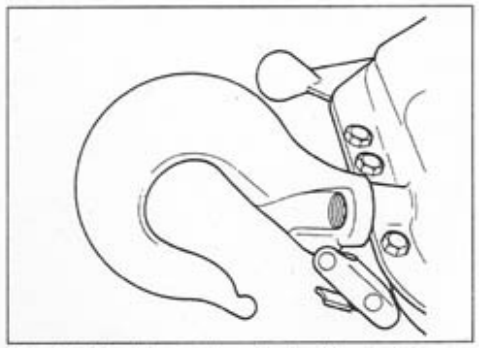


Fig. 11 - Machine anchor hook with catch in open position

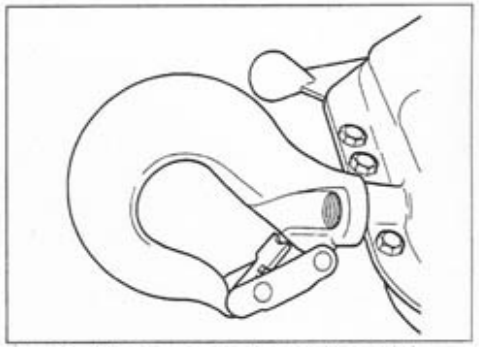


Fig. 12 - Machine anchor hook with catch in closed position.

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,
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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

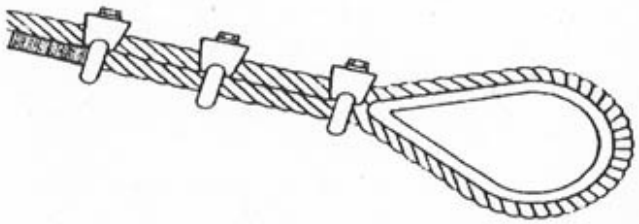
For intermediate sizes of rope the next largest grip size should be used in conjunction with the corresponding torque .

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

Fitting

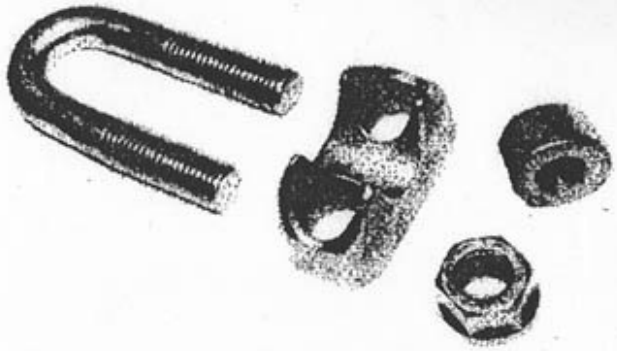
The first grip must be placed immediately against the thimble. The grips must be placed so that they are separated by a distance of approximately six rope diameters

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 C

Tower Erection and Assembly Procedure

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

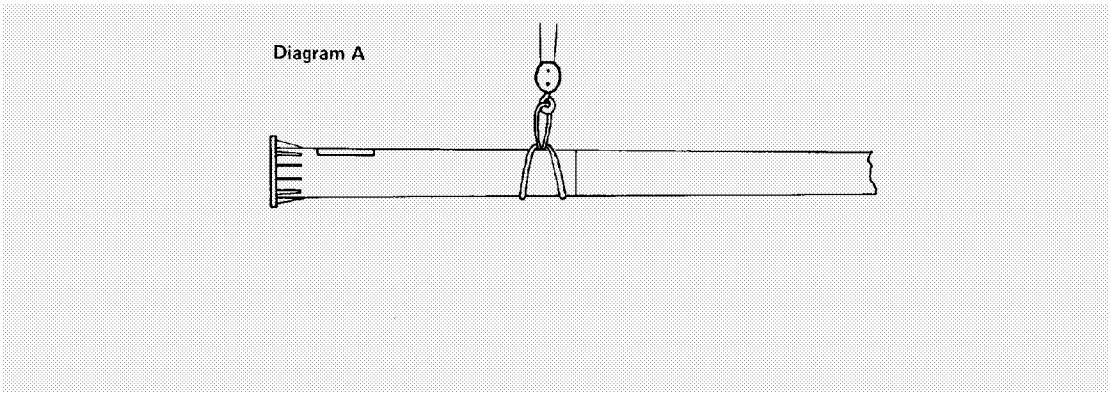
1. The joint between sections is in effect a tapered spigot and socket connection (like a fishing rod), which is first loosely assembled and then strained together into a permanent rigid assembly.
2. The order of assembly is – The base section and its adjoining section are assembled and strained together, 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

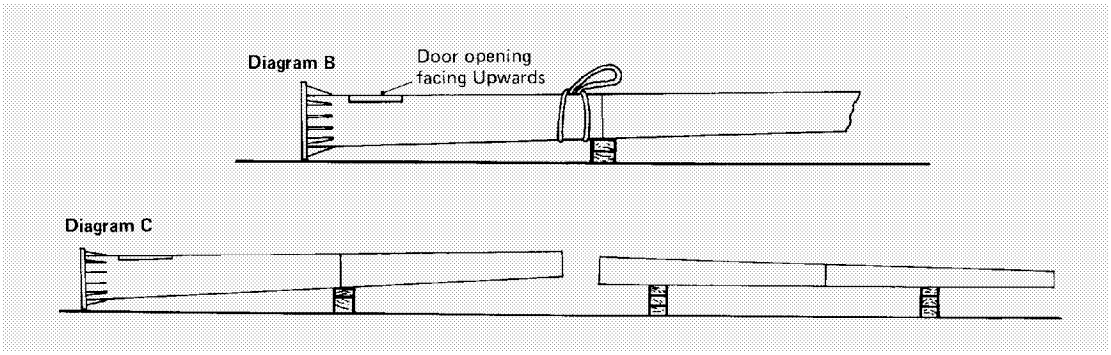
Before offloading mast sections, due consideration should be given to the assembly and erection, and each section of the mast off loaded on site accordingly. A completed mast assembly should be in a position whereby the lifting equipment can erect the mast in a single lift without transportation.

Mast Assembly Procedure

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

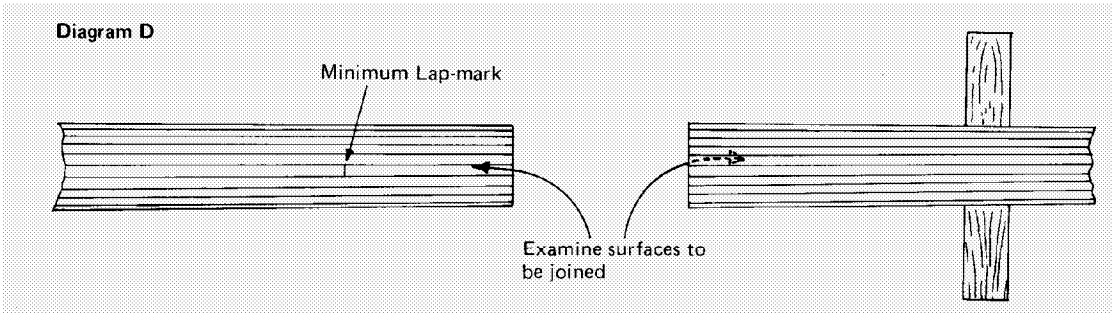


2 BASE SECTION. Determine the approximate balance point of the base section by slinging it from a crane and adjusting the sling until it balances. (See diagram A).



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).

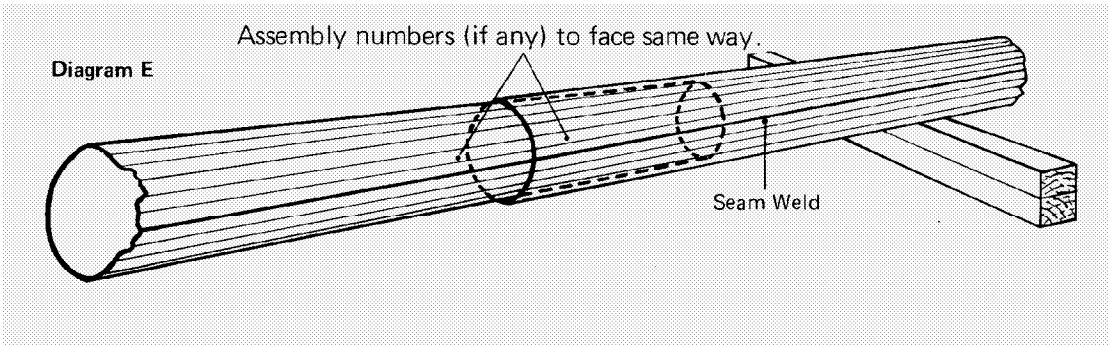


Diagram E

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.

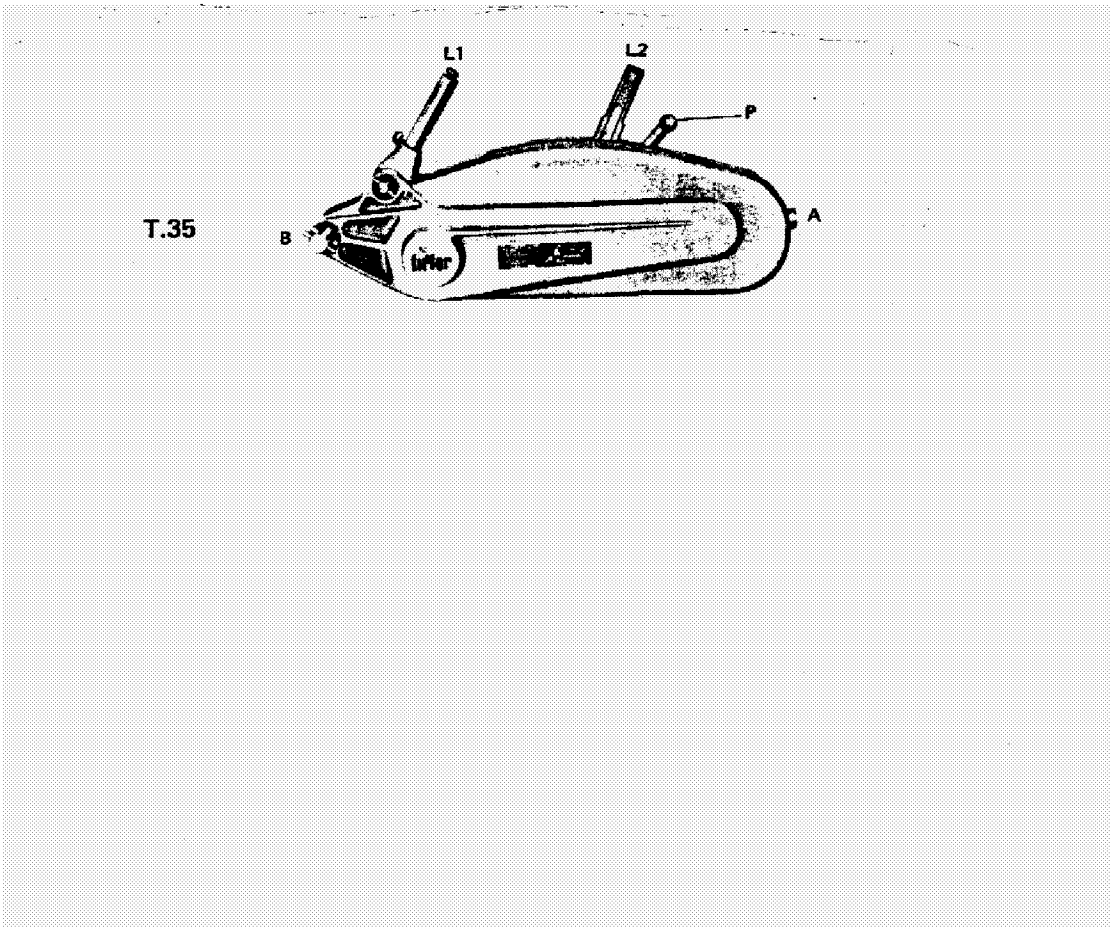


Diagram F

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).

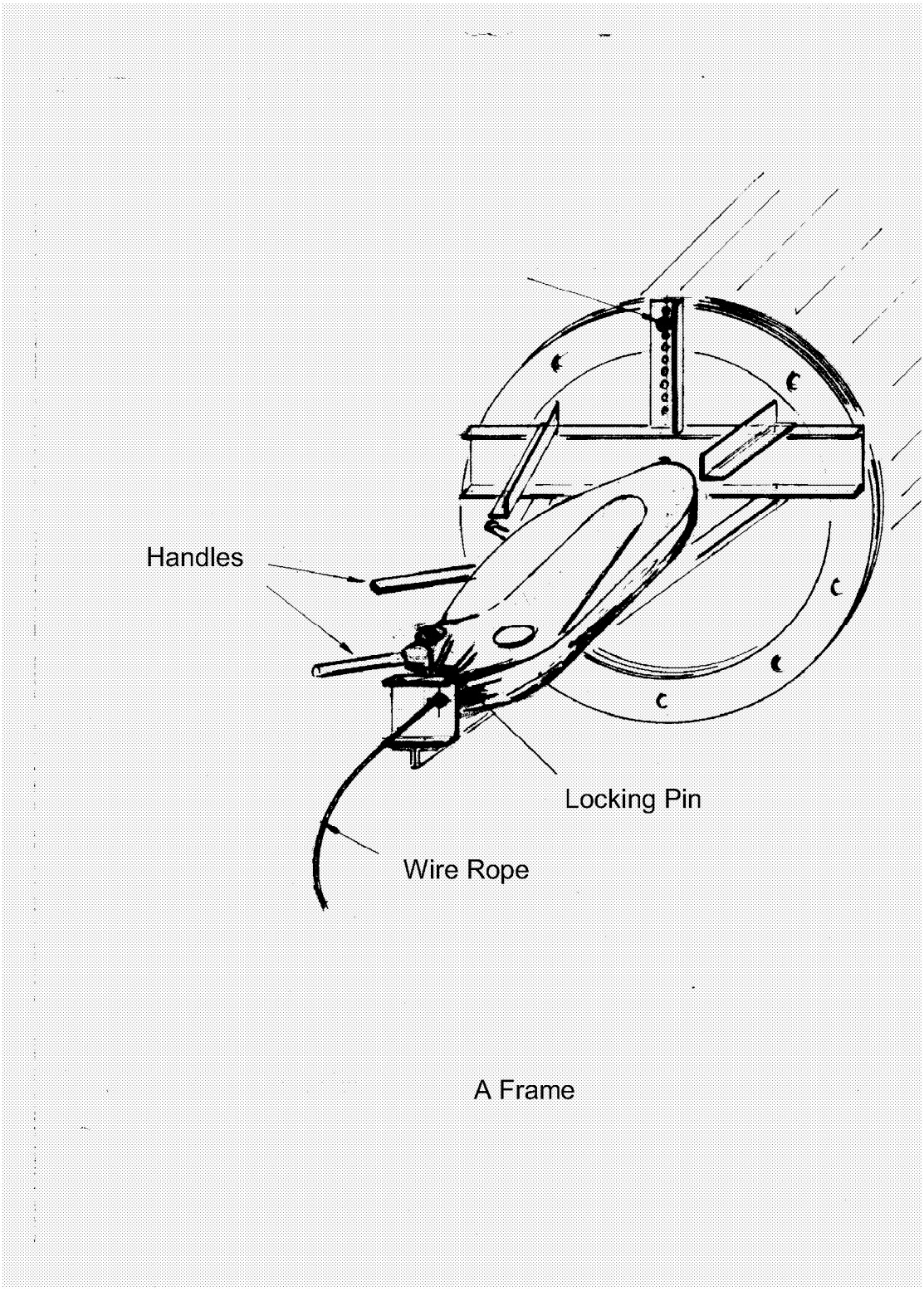


Diagram G

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.

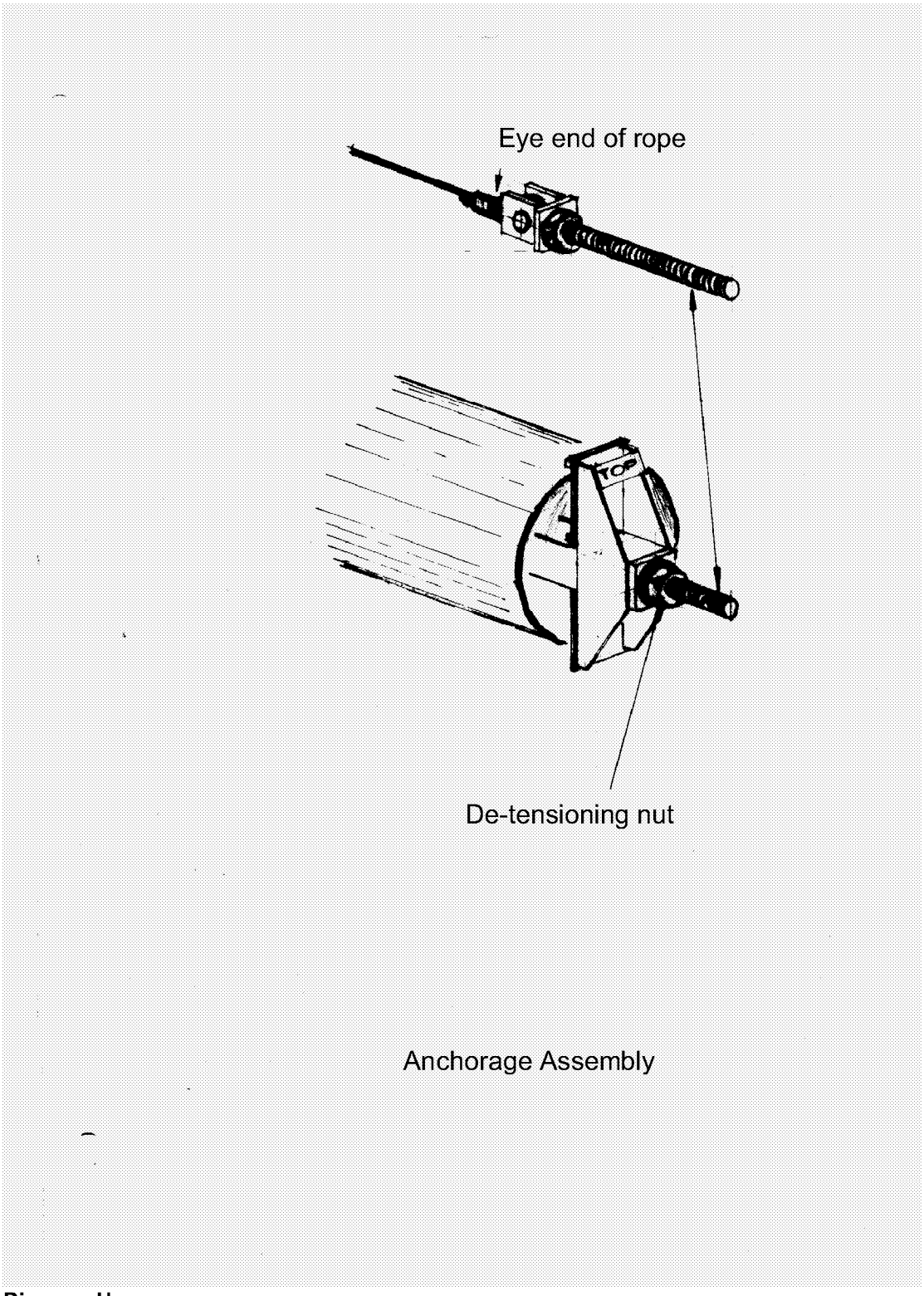


Diagram H

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

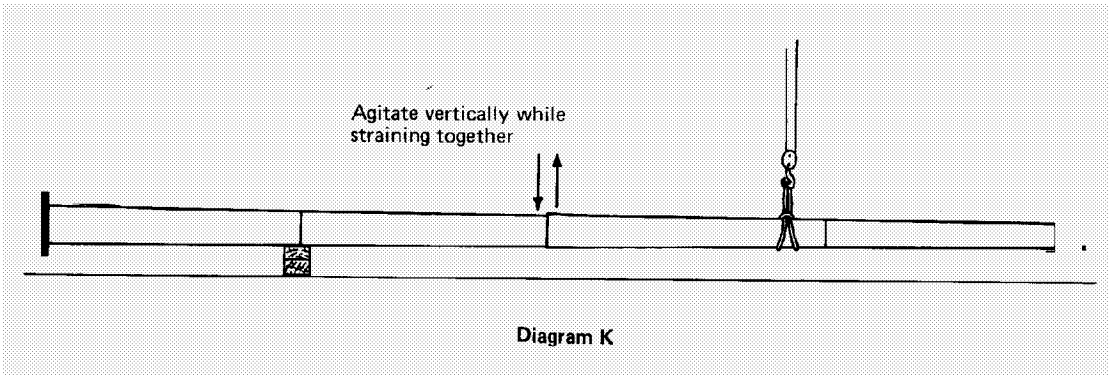


Diagram K

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.

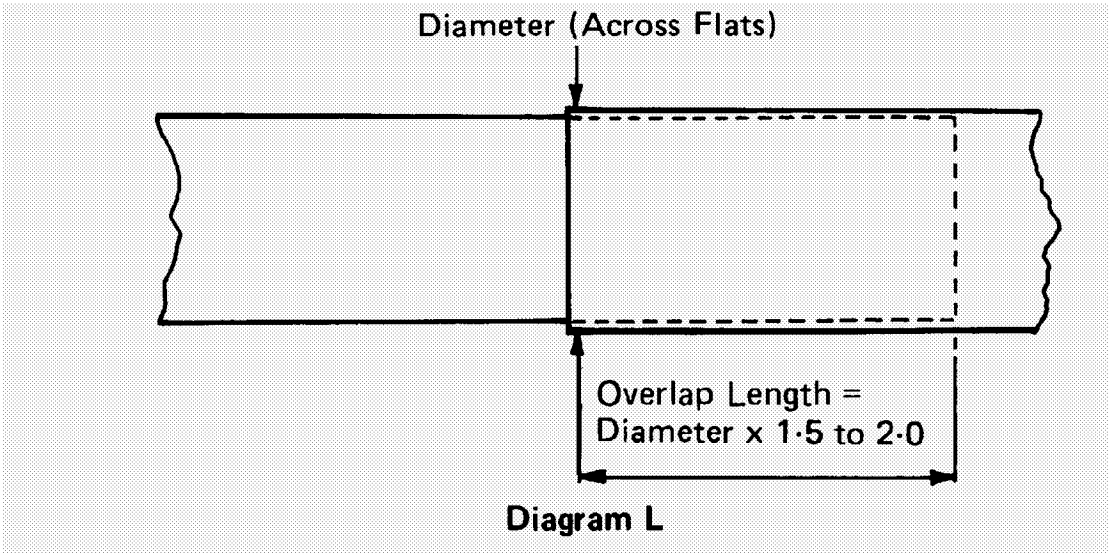


Diagram L

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 D

Torque Settings

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