WORLD CLASS BATTERY MANUFACTURER

TC2 LI-ION

CAP LAMP

MAINTENANCE AND TROUBLE SHOOTING NOTES

FIRST NATIONAL BATTERY

A DIVISION OF METINDUSTRIAL PTY LTD

REG. 1949/031259/07

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PRODUCT DESCRIPTION

The new FNB TC2 Lithium Cap Lamps are state of the art robust equipment designed to work in the toughest underground mining / tunneling conditions but also suited for many different applications.

The power source utilizes a Li-ion maintenance free battery, with enhanced features such as Intrinsic Safety, Over-charge, Over-discharge and Short-circuit protection.

The headpiece features a hi-tech LED as a light source that operates at full brilliance with the brightest light during shift.

The Lamps are fully waterproof and each lamp tested for water ingress before shipping. Lamps are 30% smaller, 60% lighter and lasts 30% longer because of the approximate 50000 hours life span of the LED. Battery requires only 10 hours of charge to reach fully charged state.

PRODUCT TECHNICAL SPECIFICATION

FEATURE	UNIT	VALUE
Nominal Voltage	Volt	3.7
Rated Capacity	Amp hour	7.0
Operating Times, Light Only, Fully Charged Battery • Main Light Only • Auxiliary Light Only	 Hours Hours	 24 52
Peak light Output Levels • Main Light • Auxiliary Light	 Candela Candela	 > 6 000 > 2 400
Current draw • Main Light • Auxiliary Light	 mA mA	 250 120
Battery Design Life @ 25°C	Cycles	800 – 1 000
Battery Recharge Time (from 90% discharged)	Hours	10 max
LED Design Life	Hours	50 000
Operating Temperature Range	Celsius	0° - 50°
Protection	Ex ia I/IIC T4	
	Model TC2	
Lamp Weights (Excluding Auxiliary Devices)	gm.	690
Battery Dimensions: • Length • Width • Height	 mm mm mm	 110 54 108
Head Piece and Cable Weight	gm.	305
Cable Length	mm	1 600

CAPLAMP CONSTRUCTION

Cap lamp assembly consists of the following:

- I.S. Battery Assembly
- LED Headpiece Assembly
- Cable

CAPLAMP OPERATION

The On / Off / Auxiliary switch of the cap lamp is located on the side of the headpiece, and will be activated by turning the knob. Switch can rotate a full 360° and will activate the main LED / off / Auxiliary LED.

IMPORTANT NOTE:

The battery is supplied at 65% charge to comply with shipping regulations. Before using lamp for the first time, lamp room attendant **must** fully charge unit before it is supplied to a miner going underground.

REPAIR AND SERVICE

- The battery does not require any maintenance except to be kept clean and to be recharged.
- If the battery is found to be faulty within the 6 months warranty period, return to FNB for warranty claim.
- If battery assembly needs cleaning, use a damp cloth and wipe – do not submerge.

WASTE DISPOSAL

Disposal of redundant batteries **must** be done in accordance to the mandatory laws of waste disposal to prevent environmental pollution – must be returned to First National Battery.

BATTERY CHARGING

The TC2 batteries can be charged on the existing charging racks. There are multi and single point chargers available from FNB on request. All batteries must be charged after each period of an 8 hour discharge shift in the following manner:

1. Fit headpiece to charge key on charging rack and rotate clockwise until locked in position ready for charge.
2. Once charger is fully loaded with batteries start charging cycle.
3. Allow batteries to remain on charge until it is fully recharged.

LAMP ROOM ROUTINE

1. Before a lamp is issued or taken it should be checked to verify that the lamp is in good working condition.
2. At the end of the working shift faulty lamps must be handed in for repair.
3. Lamps returned at the end of the working shift should be handed in to lamp room staff or placed directly on charge in a clean condition.
4. Lamps used on different shifts should, as far as possible, be segregated into different charging frames and marked accordingly.
5. Cap Lamps and accumulators held as spares should be cycled (discharged and recharged) every 3 months.
6. Once per month, lamp room attendant to re-charge lamps after shift, and then place lamps on "Burn Down" test.

- It is recommended that lamps 'BURN DOWN times remain above that required for the shift duty - e.g 8 hours

NOTE:
On taking the lamp the user must strap the accumulator to his waist & clip the headpiece to his helmet. Do not switch the lamp on until necessary. UNDER NO CIRCUMSTANCES should the accumulator be carried by the cable.

PREVENTATIVE MAINTENANCE

1. It is recommended that a quantity headpieces complete with cables be assembled and kept ready to be fitted to replace lamps which are handed in as faulty. The advantages of this system are:

   a. Minimal time is lost in returning the lamps to their charging positions.

   b. This method ensures that the replacement headpiece and cable has been completely overhauled and should function as new.

   c. The repair staff has sufficient time available to overhaul the faulty headpiece and cable for the following day/night shift.

2. The lamp room supervisor should examine a percentage of repaired lamps daily to ensure repairs are being done correctly.
3. Visually inspect all lamps after these have been placed on charge and check for loose or damaged outer covers, damaged headpieces or cables and unsealed headpieces. Also do random checks to ensure that the headpieces have been correctly inserted for correct charging.
4. For good accumulator life and recharge performance, lamp room to lamp room working shifts should not exceed 20 Hours using 7Ah Lithium battery.
5. It is important to record all repairs done and the date of these repairs to keep a control on the quality of the repair work, to eliminate the misuse of lamps by the users, and to prevent the loss of certain spares.

The TC2 battery is fitted with a 7.0Ah lithium-Ion cell. Damage to the inner lid covering the battery compartment will render the battery unsafe for service. The battery has a compartment available for gas sensing, communication and anti- vehicle collision warning equipment.

The first time a user switches on the lamp at the start the shift, the lamp will signal that it has been fully charged, by automatically flashing between high and low beam for 60 seconds. To cancel the flashing earlier, the user simply switches it off and on again. If it does not flash this way, the battery is not fully charged and may not last the full shift. This must be reported to the lamp room attendant who must determine the cause and fix the problem:

- Check that the charge point voltage is correct
- Test the charge point with another lamp to confirm it is charging correctly
- Check for loose connections on the battery and the head piece of the lamp.

Users must pay attention when switching on, as the lamp will only give this signal once. Any lamps put back on charge with the light still switched on, will automatically switch off when charge commences. When removed from charge the next day, the lamp will automatically switch on again without flashing. To confirm that it has been fully charged, it must be switched off and on again. Flashing will then operate as normal.

These batteries do not require cycling for hospitalisation purposes. However, as all cycling batteries lose capacity over their service life, it is recommended that a monthly burn down be done to ensure the lamps' burning times remain above that required for the shift duty. Replace the batteries of any lamps that do not meet this burning time, with new batteries that have been fully charged.

It is important to register the serial number of the new battery fitted to the lamp, as this is required for intrinsically safe devices.

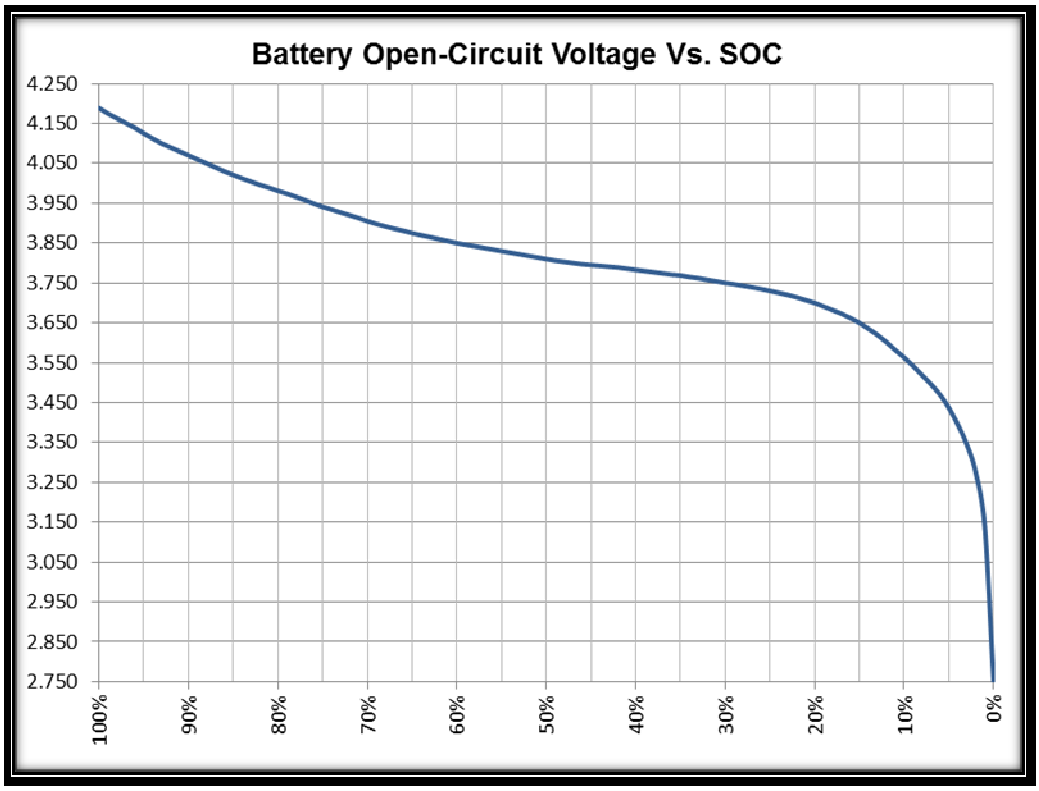
When changing batteries, take care to reconnect correctly, as the LED light and control circuits are polarity sensitive.

Lamp & battery storage

All batteries and lamps that are not put into immediate use must be given a 12 hour charge within two weeks after receipt and thereafter at 3 to 4 monthly intervals until used, when they should again be given a 12 hour charge before being put into service. For best performance, store at or below 25° Celsius in a clean, dry environment.

For maximum life, lithium Ion batteries should be stored in a partial state of charge. This is achieved by the safety circuit within the battery remaining operative, drawing a small current at all times. Conversely, this also limits the storage times between **full** recharges to a theoretical maximum of 300 days at 25°C. At higher temperatures and in practice, we recommend recharge no less frequent than every three to four months.

The graph below is useful to check the state of charge of batteries in storage. Never allow a battery to drop below a 25% state of charge whilst in storage.



Burn Down Procedure

The lamp room attendant is to perform a minimum of 8hours burn down and monitor if the light flashes within this time frame.

- If the light starts flashing, the battery must be replaced.
- If not, the battery is still good for shift duty.

Important Facts to remember

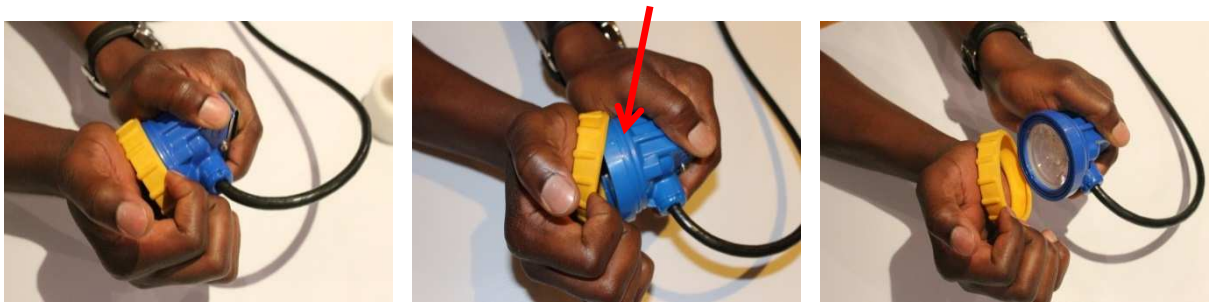
- A lamp that has switched off automatically on “low battery”, can only be switched back On by connecting it to a charger with a Volt output of 4,95 – 5,05V
- A lamp that has switched off automatically on “low battery”, must also be placed back on charge within 21 days, or the battery will be rendered unusable
- A lamp that is not used for 7 days, will go into “sleep mode” to reduce the quiescent current draw. The lamp can then only be “awakened” by connecting it to a charger with a Volt output of 4,95 – 5,05V.
- If a battery is allowed to discharge down to 2.5 Volts open circuit, the safety circuit will drop out and disconnect it for good, thus rendering the battery useless.
- Spent Lithium ion batteries must be disposed of in a certified facility in accordance with ISO14000.

Headpiece Maintenance

The headpiece requires specialised tools for opening and repair work. Attempts to open it by any other means may result in irreparable damage to parts thereof. Refer to the section covering tools below.

This lamp is fitted with an Impact Ring which is available in a number of different colours. The standard colour of issue is blue. It can be changed without affecting the integrity of the head piece. This is done by hand by unhooking the Impact Ring from the locating groove, and pulling it from headpiece as shown below. The impact ring is not necessary for the operation of the lamp and using a lamp without an impact ring is permissible.

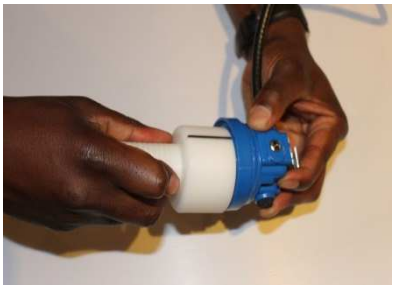
Impact Ring Location Groove



Removing the Impact Ring

Note: The light emitting diode (LED) is sensitive to moisture and contamination, and the optic can be irreparably damaged by scratching, abrasion or the use of solvents. Ensure your hands and working area are clean when working inside the head piece and if needed, wipe only with a clean dry cloth.

Removing the Lens Ring

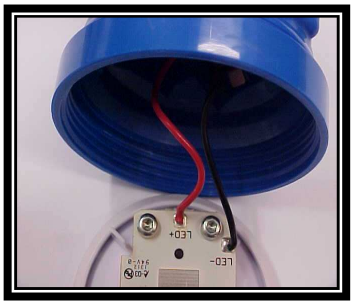



NB! Do not attempt to tighten the lens ring by any means other than the specialized tool P/N 105260 available from FNB. Failing to do so may damage the lens ring, prevent proper sealing of the lens surface to the optic gasket and render the headpiece susceptible to ingress of water and contaminants.

NB – Make sure when replacing the lens ring to align the thread of the ring to the thread of the headpiece.

Before starting to re-assemble it, make sure the head piece is completely free of moisture inside. Ensure the cable clamp is at all times in position and the cable fully clamped over the outer sheath. A loosely clamped cable will work loose and put strain on the terminals, rendering the lamp unreliable.

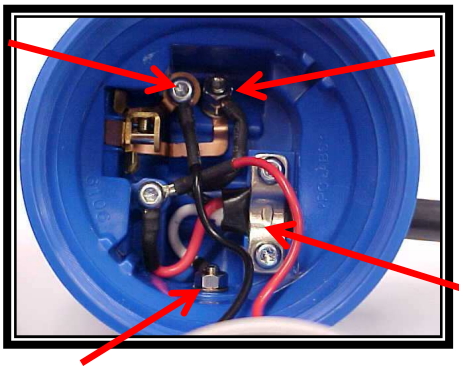
When reconnecting the cable leads, take care to reconnect correctly, as the LED light is polarity sensitive.



Connect Black Wire from LED PCB here

Connect *RED Wire from Cable* & Red Wire LED *from* PCB here

RED Wire from +LED marking on PCB
Black Wire from –LED marking on PCB



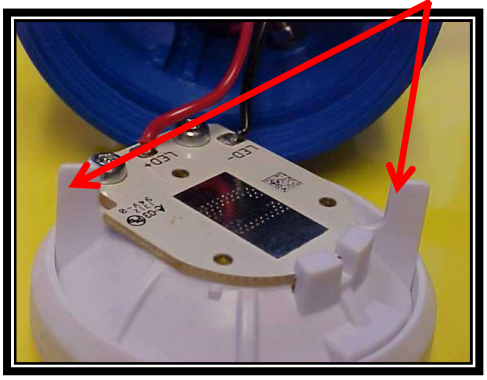
Connect Black Wire from Cable here

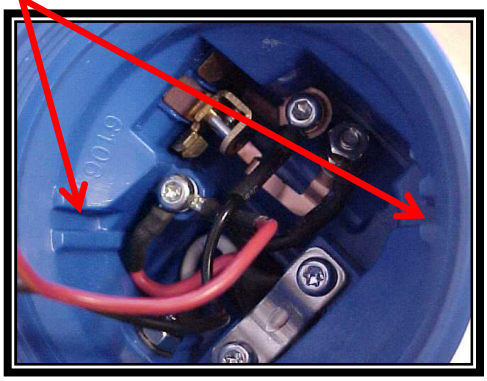
Cable Clamp

Connect White Wire from Cable here

When re fitting the optic assembly, insert the two wings of the optic holder into the slots provided in the head piece moulding to prevent the optic from rotating when tightening the lens ring.

Optic locating wings to slide down slots in headpiece moulding





For the same reasons, ensure the cable securing seal and bush, as well as the switch knob O ring seal are properly fitted and maintained using the correct tools. Ensure all O-rings have been lubricated using a light coating of **ONLY** Swift 500-H paste before assembly.

HEAD PIECE MAINTENANCE CHECK LIST

Does the LED fail to illuminate with power applied?	Y	
yes		
Is there evidence of moisture in the head piece?	N	Replace optic assembly
yes		
Is head piece moulding cracked or damaged?	Y	Replace HP moulding
Is lens ring cracked or damaged	Y	Replace lens ring
Is Optic seal worn or damaged	Y	Replace optic seal
Is switch knob O ring worn or damaged	Y	Replace Switch Knob O ring
Is cable securing bush worn or damaged?	Y	Replace securing bush
Is Cable O ring seal worn or damaged?	Y	Replace cable O ring
Is the Impact ring worn or damaged?	Y	Replace with same colour Impact ring
Is the lens ring worn, cracked or damaged?	Y	Replace lens ring
Optic sealing gasket worn or damaged?	Y	Replace sealing gasket
Optic damaged or badly scratched?	Y	Replace optic assembly
Glass lens chipped or scratched?	Y	Replace lens
Cap hook worn or damaged?	Y	Replace cap hook
Is the lock contact worn or damaged?	Y	Replace lock contact
Is the lock barrel worn or damaged?	Y	Replace lock barrel
Is the lock spring worn or damaged?	Y	Replace lock spring
Worn or corroded switch connection?	Y	Replace switch connection
Worn or corroded switch blade?	Y	Replace switch blade
Worn or damaged switch knob?	Y	Replace switch knob
Worn or damaged O ring?	Y	Replace switch O ring

Note:

Whenever O-ring seal at cable entry into the headpiece were disturbed, cable must be moved approx. 5mm inward, to provide a new seal surface on the cable for the O-ring.

Cable Maintenance

CABLE MAINTENANCE CHECK LIST

Cable securing bush worn or damaged?	Y	Replace bush
Cable O ring (Headpiece) worn or damaged?	Y	Replace O ring seal
Cable outer sheath damaged?	Y	Replace cable
Cable length > safe minimum?	N	Replace cable
Is the cable SANS 1438 marked?	N	Replace with SANS marked cable
Do all the cable leads test* for continuity?	N	Replace cable
Faulty insulation on cable ends?	Y	Repair if long enough, replace cable if not
Corroded terminal lugs?	Y	Repair if long enough, replace cable if not
Cable clamp kit fitted & in good working order	N	Fit new cable clamp kit

***Note:** Test for continuity (ohm) using multi-meter
Replace cable clamp kit whenever cable is replaced.
Cable clamp kit screws should be tightened until there is no gap between the two halves of the clamp, taking care not to over tighten

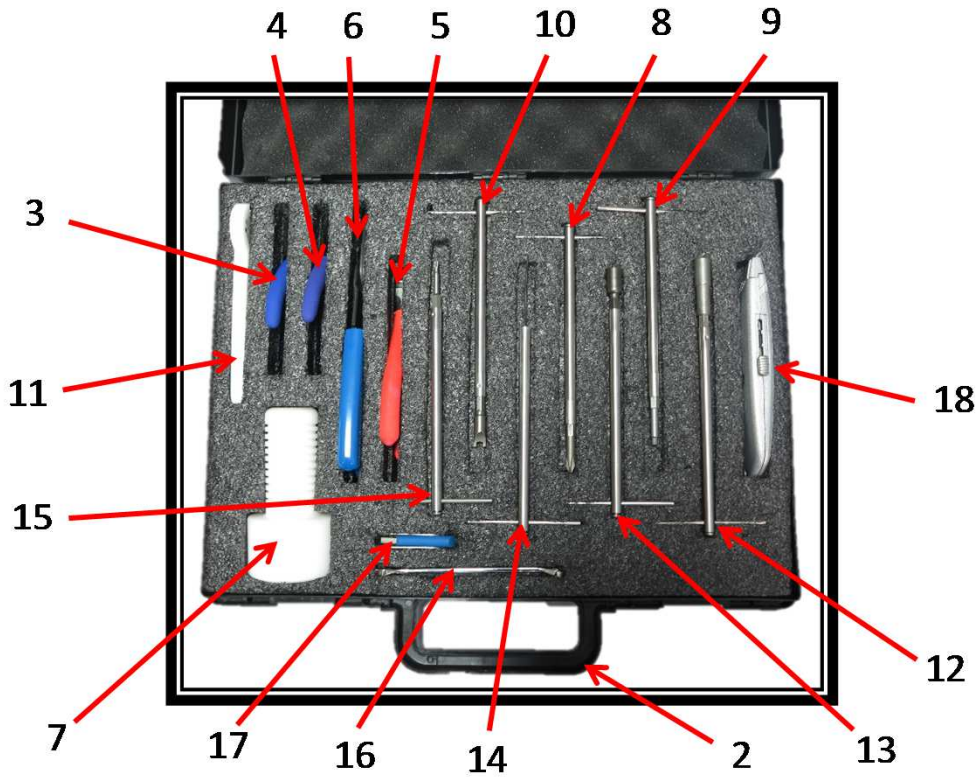
Outer Cover Maintenance

OUTER COVER MAINTENANCE CHECK LIST

Outer cover worn, cracked or damaged?	Y	Replace outer cover
Cable grommet worn, cracked or damaged?	Y	Replace cable grommet
Outer cover retaining screw in good order?	N	Replace retaining screw

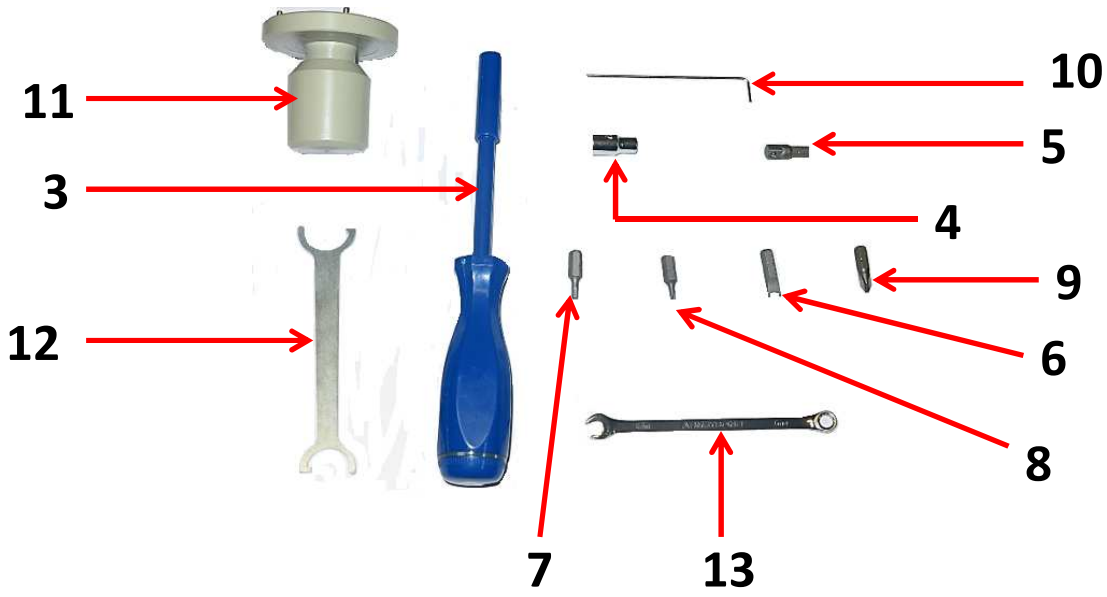
Tools required for maintaining the FNB cap lamp

It is important that the tools specially designed for this lamp type are used during its maintenance and repair work. This will ensure the lamps remain safe and can be repaired over a long period without any loss in operational performance. Contact your nearest FNB branch or distributor, for stock of these tools.



Imported Tool Box:

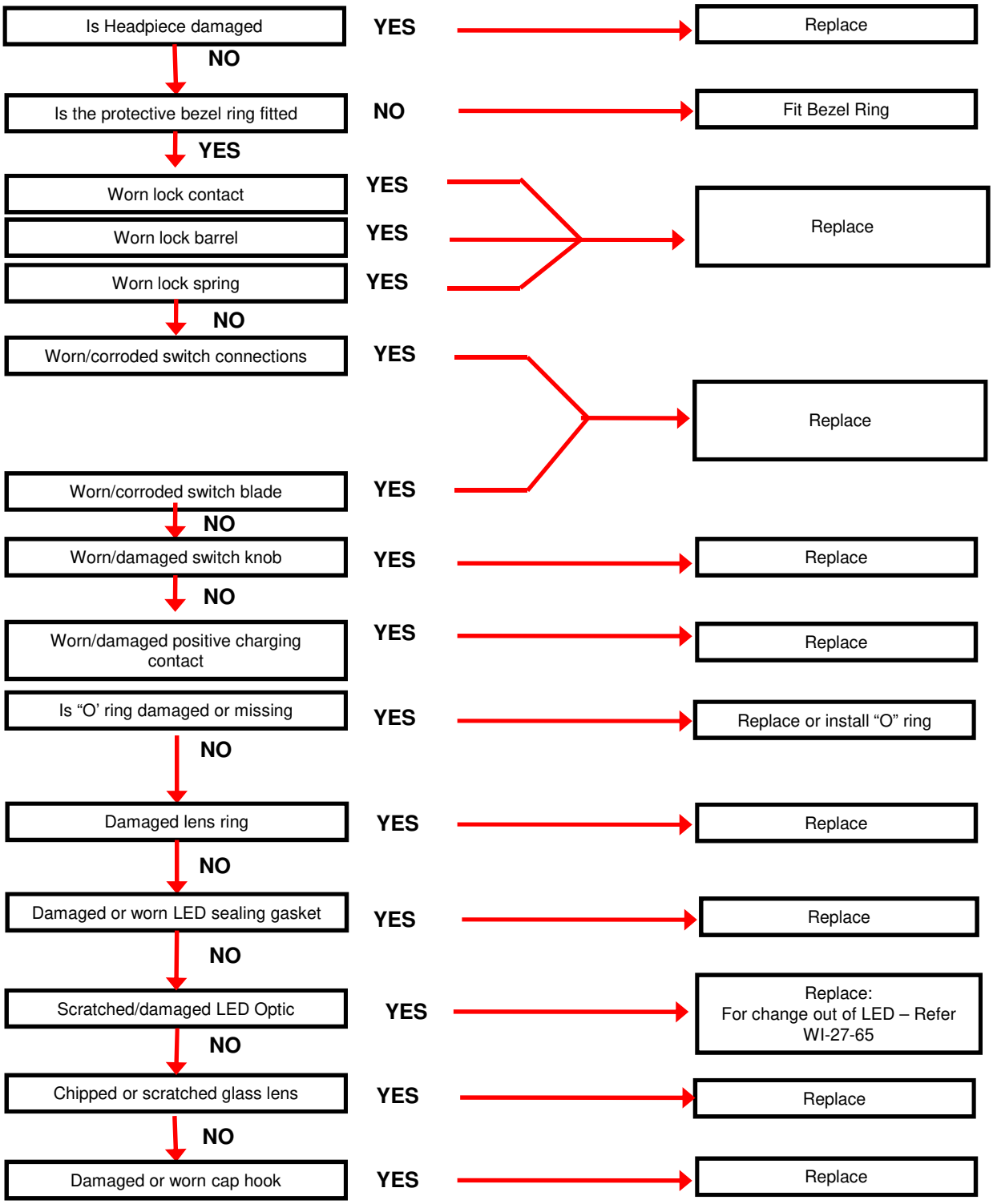
Description	Tool Code	Associated Part
1) Maintenance Tool Kit	105283	All Tooling inclusive of case
2) Tool Case Only	105278	General use
3) Flat Nose Pliers – 115mm	102033	General use
4) Long Nose Pliers – 115mm	102032	General use
5) Side Cutter – 115mm	102034	General use
6) Wire Stripper	105281	105207
7) Lens Ring Key	105260	105203
8) Lock Contact Screw Driver	105264	105214
9) Outer Cover Retaining Screw Tool	105268	105246
10) Cap Hook Screw Tool	105263	105226
11) Cable Securing Bush Spanner	105261	105220
12) Terminal Nut Driver	105269	105249
13) Charge Contact Driver	105262	105210
14) Switch Blade Grub Screw Driver	105266	105219
15) Contact Screw Assembly Tool	105282	105217 / 105272
16) 6mm Combination Offset Spanner	105280	General use
17) USB Memory Stick	105280	Documents
18) Stanley Knife	105279	General use



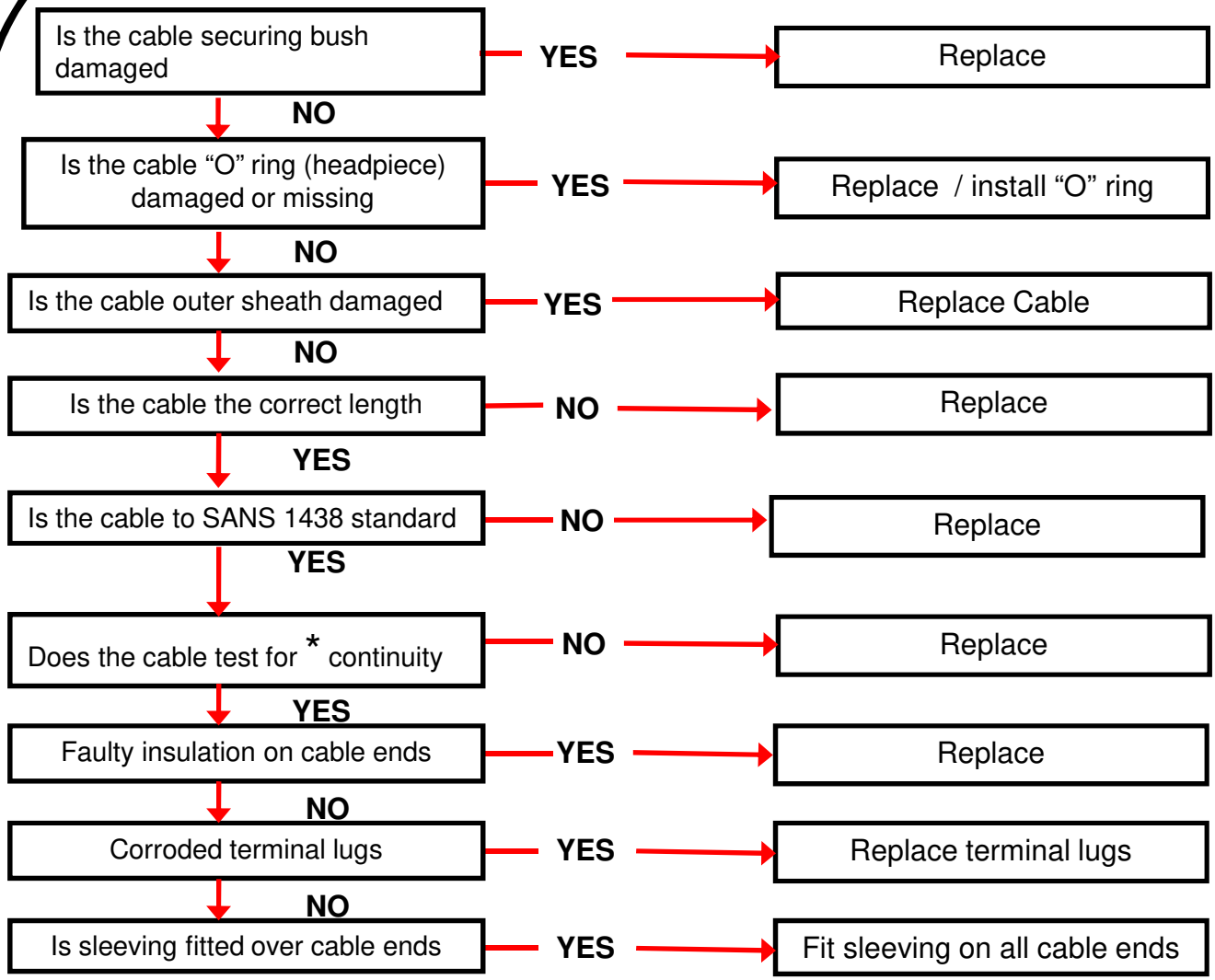
Local Toolbox Kit:

Description	Tool Code	Associated Part
1) Maintenance Tool Kit	105283L	All tooling incl. of case
2) Toolbox Only	105278L	General Use
3) ¼" Driver Handle	105262L	105210
4) ¼" Terminal Nut Socket	105269LA	105249
5) ¼" Socket Adaptor	105269LB	105249
6) ¼" Cap Hook Screw Bit	105263L	105226
7) ¼" Outer Cover Screw Bit	105268L	105246
8) ¼" Contact Screw Bit	105282L	105217 / 105272
9) ¼" Lock Contact Screw Bit	105264L	105214
10) Grub Screw Allen Key	105266L	105219
11) TC Lens Ring Key	105260L	105203
12) Cable Bush Combo Spanner	102016L	105220
13) 6mm A/F Combination Spanner	105280L	105212

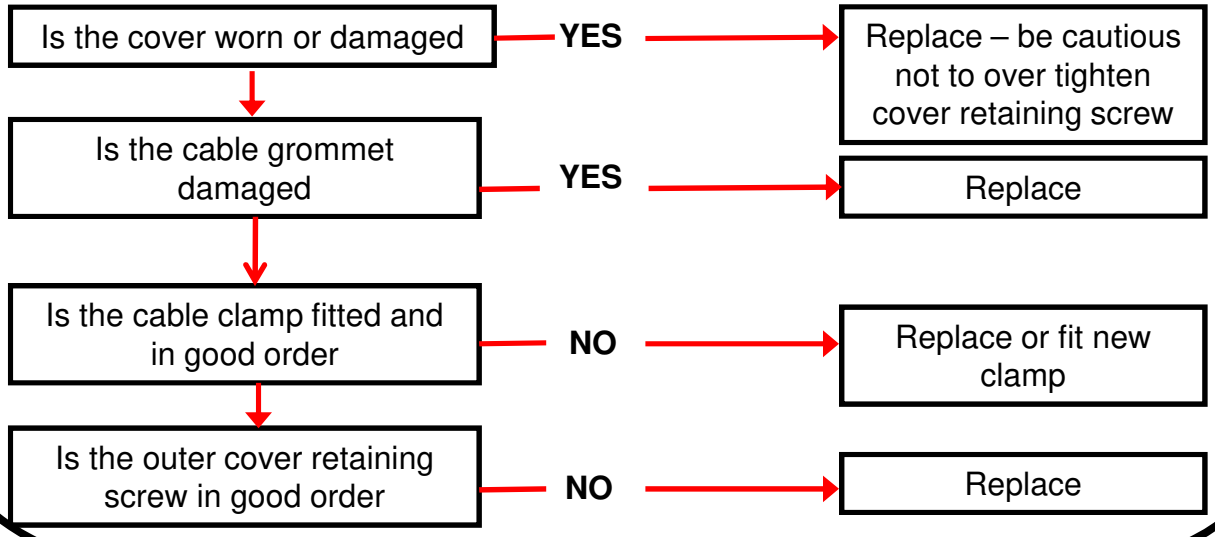
TC2 HEADPIECE MAINTENANCE



CABLE MAINTENANCE



OUTER COVER MAINTENANCE



*** Note: test for continuity (ohm) using multimeter**

TC 2 ACCUMULATOR HOSPITALISATION PROCEDURE

1 Is accumulator physically damaged

YES → If damaged, No Warranty

Dispose of as per mandatory laws of waste disposal to prevent environmental pollution

NO

2 Is battery voltage to spec? – See Note 1

YES

3 Connect a good headpiece to the Accumulator – See Note 2

4 Accumulators: Charge at 5.0 V for min 8 hours and max 12 hours

5 Discharge batteries using LED headpiece for 12 hours

6 Final voltage below 3.7V

Final voltage above 3.7V

Final voltage above 4.2V

Notes:

1. **Measure battery voltage – check voltage over LED (Pos) and GND (Neg) terminals = 3,7V**
2. **When checking voltages, allow a rest period of at least 2 minutes before taking voltage readings.**
3. **When accumulators are being hospitalized, connect the charge cable crocodile clip from positive charge terminal to positive connection plate & Negative GDN terminal to the charge key on the charger as follows:**

Final voltage below 3.7V → Retain accumulator for assessment by First National Battery if **within** warranty period | If out of warranty period

7 Repeat steps 4, 5, 6

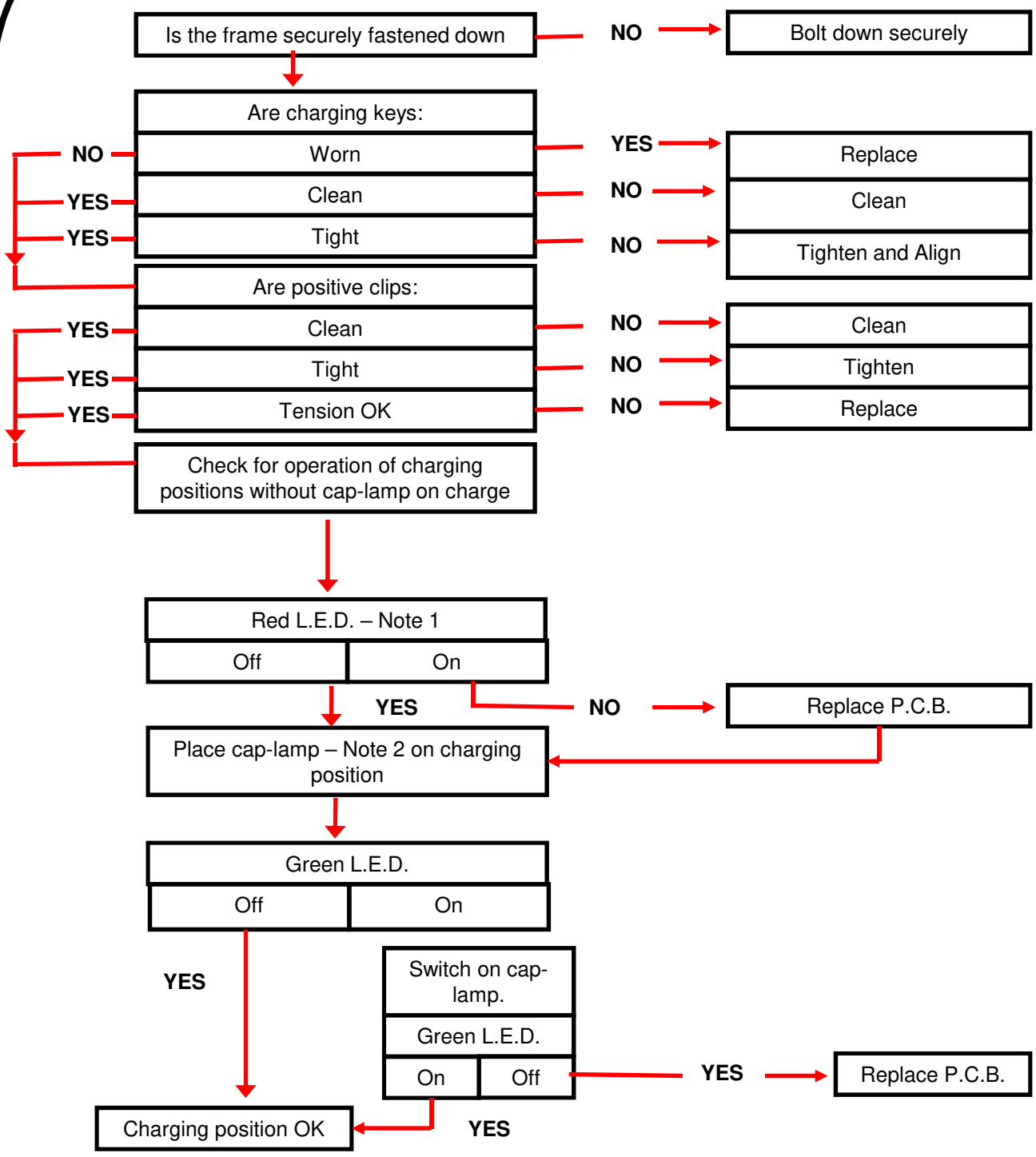
Replace

8 Voltage above 4.2V return to service

Voltage below 3.7V

Voltage above 4.2V

MAINTENANCE FOR STAINLESS STEEL CHARGING FRAME



Note 1 – Should the RED L.E.D. indicate ON when the cap-lamp is placed on charge – the lamp/accumulator is faulty – check accumulator and headpiece for polarity and for short circuits.

Note2 – To test the charging positions ensure that a fully charged accumulator is used. The cap-lamp must be in good working condition.

Note3 – On a regular basis check the charger D.C. output voltage and charging position voltages, which must read between 4.95 and 5.05 volts. Should, at any charging position, the L.E.D.'s flicker or charging positions read low voltages the P.C.B. must be checked for loose connections.

MAJOR CAP-LAMP CHARGER

For LED 4V Lead-Acid Lamps

Service Conditions

The equipment is suitable for operation in ambient temperatures not exceeding 40°C or temperatures ranging between 10 – 35°C at altitudes from sea level to 2000m above sea level.

A.C. Input

The equipment is designed to operate from a three phase 50 Hz A.C. supply, having a nominal voltage of 380 – 525 volts. The voltage may vary by a maximum 10% without materially effecting the output of the charger.

D.C. Output

The equipment has been designed to recharge 2 cell, 4.0V nominal Lead-Acid accumulators and can also recharge the TC2 3.7V Li-ion accumulators.

Maximum output current	**-**	**300 amps at 5.0V nominal;**
C.V.C. voltage	**-**	**adjustable between 4.95 volts and 5.05 volts**
Lamp capacity	**-**	**recommended 204 cap-lamps maximum**

Maintenance

The charger requires no preventative maintenance apart from occasional cleaning to prevent "tracking" due to a build-up of conductive dirt.

Cabling

The D.C. supply cable from the charger output to the charging frame must not be less than 70mm^2 and must be firmly bolted at the charger and frame connection points. The lugs should preferably be soldered and not crimped.

Charger Protection

3 Phase circuit breaker in the A.C. input.
Fuse protection in the diode circuit.
Transient suppression network.

The unit is factory pre-set and should not be tampered with by unauthorised personnel. Incorrect adjustment can damage the charger or accumulators. If the charger is suspect, contact a qualified electrician.

Warning

High voltage testers, meggers, etc. should not be used for checking the charger or frame circuitry as this will damage the electronic circuits.

SWITCH MODE POWER SUPPLY CAP LAMP CHARGER

For LED 4V Lead-Acid Lamps

Service Conditions

The equipment is suitable for operation in ambient temperatures not exceeding 40°C or temperatures ranging between 10 – 35°C at altitudes from sea level to 2000m above sea level.

A.C. Input

The equipment is designed to operate from a single phase 50 Hz A.C. supply, having a nominal voltage of 200 – 240 volts.

D.C. Output

The equipment has been designed to recharge 2 cell, 4.0V nominal Lead-Acid accumulators and can also recharge the TC2 3.7V Li-ion accumulators.

Maximum output current	**-**	**200 Amp at 5.0V nominal;**
Voltage	**-**	**4.95 volt ~ 5.05 volt**
Lamp capacity	**-**	**recommended 102 cap-lamps maximum**

Maintenance

The charger requires no preventative maintenance apart from occasional cleaning to prevent "tracking" due to a build-up of conductive dirt. Also ensure that the internal fan is in clean working order and free from dust build up.

Cabling

Each unit is factory assembled and all cabling conforms to specifications.

Charger Protection

2 Pole circuit breakers installed at the A.C. supply.
Transient suppression network.
The unit is factory pre-set and should not be tampered with by unauthorised personal. Incorrect adjustment can damage the charger or accumulators. If the charger is suspect, contact a qualified electrician.

Warning

High voltage testers, and meggers etc. should not be used for checking the charger or frame circuitry as this will damage the electronic circuits.