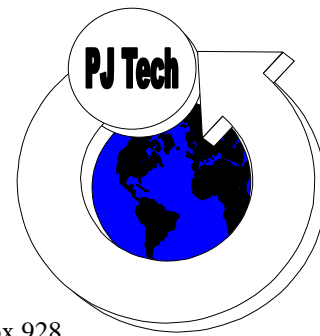


PJ Tech

Reg. No: CK94/30139/23
V.A.T. No: 4240179202

Cap Lamps



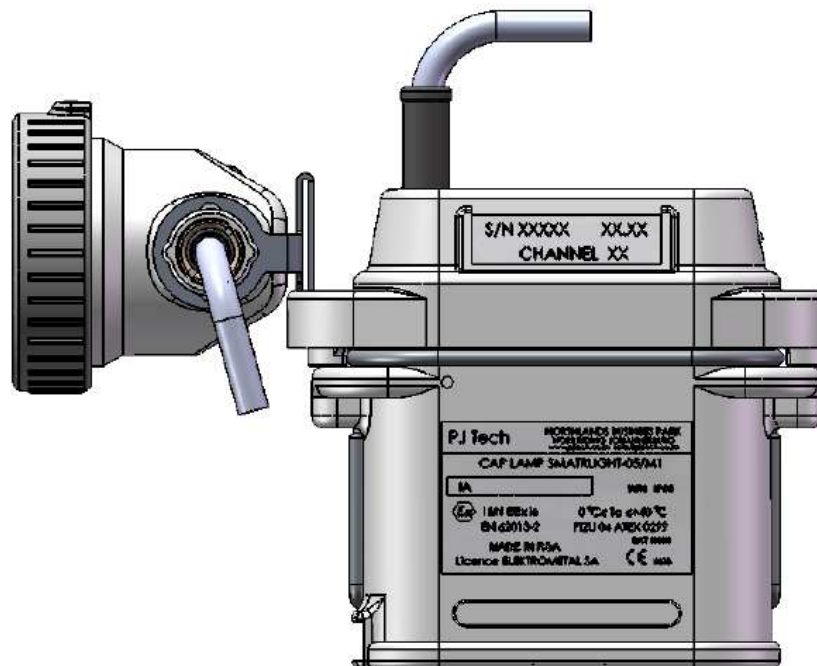
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CAP LAMP SMARTLIGHT 05-M1 MK3

OPERATING & MAINTENANCE INSTRUCTIONS MANUAL





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1 DESIGNATION

The SMARTLIGHT-05/M1 cap lamp is designed for individual illumination of workplace. The lamp's body is **IP65** rated and the internal design conforms to **ia** standard. The lamp can be used in the mines and places contaminated with methane at any concentration. Cap lamp uses the NiMH service-free battery to ensure good illumination in different work conditions. The lamp is equipped as **standard with the lamp location transmitter**. As options it can be equipped with:

- RFID transponder to monitor movements of the personnel
- methane meter to monitor methane levels

2 TECHNICAL SPECIFICATIONS


Description	Data	
Rated voltage of battery	3,6 V	
Battery	3 x NiMH 9,5 Ah	
Battery life	800 cycles	
Source of light:	Main light MLED	diode LED 1W
	Additional light ALED	diode LED 0,07W
	Emergency light ELED	diode LED 0,07W
Light source life	100,000 hrs	
Battery utilisation from full charge	MLED only at 100%	15 hours
Example of battery utilisation in sequence (from full charge of battery)	MLED at 100%	10 hours than
	MLED at 20%	7 hours (80% battery capacity depleted) than
	ALED or ELED	20 hours
Minimum period of position transmitter's functioning	170 hours	
Battery maximum charging period	12 hours (from completely discharged)	
Light intensity at 1m from the lamp	+- 1900 lux (after 8 hours of 100% usage)	
Light beam angle	120 deg	
Ingress protection	IP 65	
Level of protection explosion-proof	 I M1 Ex ia I; Certification No: FTZU04ATEX0299	
Dimensions	140 x 130 x 48 mm	
Head diameter	72 mm	
Cable length	1500 mm	
Working temperature	0 ⁰ ...+ 40 ⁰ C	
Weight	1,3 kg	

Table No.:1- Technical Specifications



"CE" marking is a declaration from the manufacturer that their product conforms to a specific Directive(s) adopted by the EEA (European Economic Area) and is a requirement for the product to be sold into any of the countries in this 18 member group. CE is an abbreviation for the French phrase Conformité Européenne, meaning European Conformance. Unlike hazardous location approvals, the manufacturers are solely responsible for ensuring their product's conformance to these Directives which were developed using IEC and Cenelec standards.



These are some of the recognized European approval agencies that have certified Viatran transmitters to Cenelec (European Committee for Electrotechnical Standardization) and/or IEC (International Electrotechnical Commission) standards for hazardous locations. Cenelec attempts to harmonize the electrical standards of its member countries. Generally, IEC standards are used. However, in certain instances where IEC standards are considered too vague, Cenelec defines more precise requirements.



3 CAP LAMP CONSTRUCTION

Cap lamp consists of the following:

- Battery Casing.
- Head Lamp.
- Cable (links the Battery Casing with the Head Lamp).

3.1 Battery Casing

The Battery Casing consists of the following:

- Enclosure that is made of a robust plastic. At the bottom of the enclosure there are three contacts that are used to charge the battery and transmit data to the cap lamp and back.
- NiMH Battery Set that supplies electrical power to the cap lamp. After inserting the cap lamp into a charger, the battery is charged through contacts at the bottom of the enclosure. The working and charging cycles of the battery are controlled by microprocessor.
- Plate containing a pressure relief micro-valve, separating the battery from the PC board. The micro-valve releases the air from the enclosure and it opens if the enclosure's inside pressure exceeds 0.3bar .
- Electronic Board – Ref.. page 10 - that contains a microprocessor as well as other electronic components. The electronic board controls the operation of the cap lamp. The electronic board is equipped with the following:
 - Plug-in Socket to connect the casing cover (Figure 1-3) to the battery set (Figure 1-1). Programmer unit can also be connected via the plug-in socket.
 - Terminal Strip to connect a cable (Figure 1-5) linking the battery set (Figure 1-1) to the head lamp (Figure 1-6). The electronic board is encapsulated in the casing cover with a polyurethane filling.
- Battery Casing Cover – Ref. page 10 - (Figure 1-3) is made of a high impact resistant plastic. The cover is mounted to the enclosure with two six lobe bolts. A special rubber seal (Figure 1-4) ensures tight fit. An emergency ELED diode is encapsulated in the cover. The cover (Figure 1-3) has a cable inlet for the cable that connects the battery set (Figure 1-1) to the head lamp (Figure 1-6). The lamp's membrane switch (Figure 1-10) is located on the opposite site on the top of the cover. The cover (Figure 1-3) is connected to the electronic board by means of a cable with a connector pin. In case of a cable (Figure 1-5) breakage between the head lamp and the battery, the ELED emergency diode mounted in the cover of the battery casing (Figure 1-3) starts to emit continuous light. The ELED diode light protects the users from a complete loss of light.
- Position Transmitter built into the cover constantly emits a signal of a fixed frequency. Transmitter is part of the system which purpose is to locate trapped personnel affected by the underground rock falls. ELED that is visible through the cover of the battery casing signals proper functioning of the transmitter by flashing. In order to ensure that the transmitter is operational for the required 7 days the lamp is equipped with an electronic light cut-off switch build into the battery enclosure. For technical specification see Table No 2 and for operational parameters of the transmitter see Table No 3.

The battery casing can be fitted to a hip belt by means of a stainless steel wire belt bracket (Figure 1-2) that is fitted to the battery casing.



Description	Data
Rated voltage	3.6V (Lamp's battery)
Maximum current draw	20mA
Channel frequency	See Table No 3
Number of channels	8

Table No.2: - Transmitter Technical Specification

No	Channel No	Nominal Frequency [Hz] $\pm 80\text{Hz}$
1	05	4100
2	10	4350
3	15	4600
4	20	4850
5	25	5100
6	30	5350
7	35	5600
8	40	5850

Table No.3: - Transmitter Nominal Frequencies

3.2 Head Lamp

The head lamp consists of the following:

- Lamp Body (Figure 1-6).
- Lamp Treaded Cover (Figure 1-7).
- Lamp Clip (Figure 1-12).
- Protective Glass (Figure 1-9) with a Seal (Figure 1-8).
- Reflector Set (Figure 1-11).
- Cable Inlet.

The body and threaded cover are made of plastic. The head is equipped with a metal lamp clip that allows clipping it on a helmet. On the side of the lamp body there is a cable entry that connects the lamp with the battery set. The body is enclosed by means of the threaded cover with the protective glass. The threaded cover's tightness and possibility of unscrewing is ensured by means of the seal and locking screw. The reflector set is mounted inside the threaded cover. The MLED and ALED are embedded in the reflector and to replace a light source the whole assembly must be replaced. The lamp clip (Figure 1-12) allows a change of the angle of the light beam relative to miners cap.

3.3 Cable

The cap lamp battery casing is connected the head lamp with a four core cable (Figure 1-5). The cable is 1,5m long. The cable is characterized by the following:

- High durability.
- Flexibility.
- Resistance to humidity and hydraulic oil.
- Non-flammable.

The cable can be fixed to the miners cap.



4 CAP LAMP OPERATION

4.1 Operation

4.1.1 Control of Operation

Each time the membrane switch (Figure 1-10) is pressed for about 1 sec it changes sequentially mode of operation as follows:

- The MLED switches on at 100% power
- The MLED dims to 20% power
- The MLED switches off, ALED switches on
- The ALED switches off, ELED switches on

Next time the membrane switch is pressed the cycle starts again. If the membrane switch is pressed for longer than 2 seconds all diodes switch off (the position transmitter is still transmitting). To switch the lamp on the membrane switch (Figure 1-10) must be pressed again. If the membrane switch is pressed for longer than 10 seconds (the MLED will signal it by a single flash) the lamp becomes ready for the battery capacity measuring procedure. The lamp exits this mode after 30 seconds if it is not placed in the charger or after the next press of the membrane switch. Once the lamp is inserted into the charger within 30 seconds from entering capacity measuring mode an internal flag is activated and it is only deactivated once the battery is fully charged. If removed before the charge cycle is completed the charge indicator of the charger will indicate that the capacity test was interrupted.

IMPORTANT NOTES!

- **During charging mode the membrane switch's functions are disabled.**
- **The light intensity and functions of each 1 second presses can be factory programmed to suit Client's requirements.**



4.1.2 Functioning of the Position Transmitter, Cable Continuity & Voltage Monitoring

Microcontroller continuously monitors operating frequency of the position transmitter. If the frequency falls out of the prescribed range (see Table: 3) ELED switches off. Otherwise the diode flashes according to the state of the battery charge level.

Microcontroller controls the connection continuity. In case of cable (Figure 1-5) breakage, the Emergency ELED switches on. The ELED is located in the cover of the battery casing.

In addition to the monitoring of the cable's continuity, the battery voltage is also monitored. Depending on the voltage values, transmitter operation and cable condition the microprocessor indicates with the flashing ELED as follows:

State of the Position Transmitter	Cable condition	ELED	
		Ubat \geq 3.0V	UBat<3.0V
OK	OK	Flashing	Off
	Break or Short-circuit	Continuous light	Off
Malfunction	OK	Off	Off
	Break or Short-circuit	Continuous light	Off

Table No.:4 – ELED Reaction Related to the Conditions of Position Transmitter and Cable, and Battery Voltage

IMPORTANT NOTE!

In case of cable breakage the ELED switches on continuously (Table No. 4) even if Position Transmitter is faulty



4.1.3 Monitoring Battery Capacity

After the lamp is switched on for the first time so is the microcontroller. At that time the microprocessor does not have any information about the state of the charge of the battery. The process of battery's initial discharge is based on the voltage measurement.

After the battery is discharged and subsequently fully charged all control of the charge level is maintained by the microcontroller which measures the flow of the electric charge from and to the battery. In parallel with the charge flow measurement the microcontroller monitors the time the diodes are switched on. During working cycle (lamp usage) from fully charged, the minimum time the MLED must be able to emit light at 100% intensity is 10 hours. After that time the base factor determining the functioning of the lamp is the amount of consumed charge. Once the total consumed charge reaches 4.5Ah the normal operation of the lamp is disabled. During this period ALED can be switched on for a period of 3 seconds at the time. During the lamp usage, in parallel with the used charge measurement the battery voltage is measured. Once the voltage drops below 3V then irrespective of the time the MLED is switched on or the amount of consumed charge the whole operation of the lamp is EMERGENCY DISABLED. In this case the position transmitter remains the only fully functional element of the lamp.

During lamp usage the microcontroller indicates the following levels of discharge:

- 80% discharge of the capacity dedicated to the lamp - MLED flashes 6 times
- 99% discharge of the capacity dedicated to the lamp – MLED flashes 3 times

Actual level of battery's remaining capacity is constantly indicated by the ELED flashing as follows:

- 81-100% capacity remaining – ELED flashes 5 times
- 61 -80% capacity remaining – ELED flashes 4 times
- 41-60% capacity remaining – ELED flashes 3 times
- 21-40% capacity remaining – ELED flashes 2 times
- 0-20% capacity remaining – ELED flashes 1 time

The ELED flashes in the following pattern: 200ms – flash, 300ms pause, 2.5s pause between the cycles.

IMPORTANT NOTE!

Due to SAFETY REASONS the POSITION TRANSMITTER OPERATES AT ALL TIMES! If the cap lamp is not used/charged for 7 days then the electronic board with microcontroller MUST be disconnected (connector under the battery casing cover must be disconnected- Figure 1-3).



4.2 Battery Charging

4.2.1 Battery Chargers

The SMARTLIGHT-05/M1 cap lamps to be charged only in the following charging devices:

Charger Lamp Capacity	Charger Type	Part Number
1	Charger module only (any charger type)	PCL-SM05-CHRG/MOD
1	Single (desktop)	PCL-SM05-CHRG/1
5	Stand alone (desktop or bench)	PCL-SM05-CHRG/5
17	Row (part of PCL-SM05-CHRG/102)	PCL-SM05-CHRG/17
102	Stand Alone	PCL-SM05-CHRG/102

IMPORTANT NOTE!

**All lamps are delivered with discharged and conditioned batteries
To enable initial battery charge the electronic board with microcontroller must be connected to the battery by means of a connector under the battery casing cover (Figure 1-3).**

4.2.2 Initial Battery Charge

When a new lamp is placed into the charger or after the electronic board with microprocessor is disconnected from the battery connector, or after full discharge the lamp enters Initial Charge Mode. If there is any charge left in the battery the LEDs switch on and the discharge cycle starts. After the battery is fully discharged LEDs switch off and the charging cycle starts. During this cycle the microprocessor calibrates the battery. This should not be interrupted until finished.

4.2.3 Standard Charging Modes

There are two battery charging modes:

4.2.3.1 Standard Battery Charge

To enable this function the user must insert the battery into the charger. All the LEDs will switch off and the microprocessor will calculate the amount of charge which should flow into the battery. The charging cycle starts and ends once the required amount of charge is supplied to the battery. If the battery temperature exceeds the allowable level the charging stops and resumes once the temperature drops.

The battery is fully charged when:

- The battery has received the calculated electric charge, or
- Battery voltage >4.45V.

Once the charging cycle is completed the battery is being trickle charged by 20% of the interrupted current.

Note: Discharging + charging mode can also be used (4.2.3.2).



4.2.3.2 Discharging + Charging (Calibration Mode)

To enable this function the user must press the membrane switch for approximately 10 seconds (the MLED will signal it by a single flash). The lamp becomes ready for the battery capacity measuring procedure. The lamp exits this mode after 30 seconds if it is not placed in the charger or after the next press of the switch. Once the lamp is put into the charger within 30 seconds from entering calibration mode an internal flag is activated and it is only deactivated once the battery is fully charged. The LEDs will switch on to discharge the battery. Once the discharge cycle is completed the LEDs will switch off and the charging cycle will begin. After the lamp is fully charged and removed from the charger the MLED switches on.

Note:

Should the charging cycle be interrupted (e.g. battery removed from the charger) MLED will not switch on after the lamp is removed from the charger. Another attempt to put the battery into the charger will result with the charging indicator of the charger indicating that the capacity test was interrupted.

Once the charging cycle is completed the battery is being trickle charged by 20% of the interrupted current.



5 DATA TRANSMISSION

Data transmission is activated when the battery is being charged. The data is sent from the cap lamp to the battery charger and can be viewed and analysed via PC software system. Data frames are sent at intervals of 500 milliseconds. Commands from the PC software system are sent in alternate fashion. Data frames are of a fixed size but the commands frames vary in size.



6 REPAIR AND SERVICE

The cap lamp construction allows for no additional operating activities. The battery consists of dry cells that are sealed inside the battery casing. The average life time of the NiMH battery is 800 cycles.

IMPORTANT NOTE!

Only authorized and adequately trained personnel can be allowed to perform the inspections and repairs. Should the cap lamp malfunction in any way, PJ Tech should be informed.

6.1 Periodic Inspection

It is recommended that from time to time the following are inspected (cracks, material deterioration):

- Head lamp.
- Cable.
- Battery casing cover.
- Battery set.

IMPORTANT NOTE!

Should the cable be replaced and the head lamp opened, one should make sure not to allow any impurities onto the lens of the LEDs.

6.2 Annual Inspection

It is recommended that at least once a year the following are inspected:

- Seal of the battery casing cover.
- Seal of the head lamp.

6.3 Random Checks

To ensure the efficiency of the lamp's illumination, it is recommended that random checks are performed. Operation of the push button's as well as lamp's illumination to be checked during these checks.



7 WASTE DISPOSAL

Packages and used devices should be disposed of according to the mandatory local Laws of waste disposal.

8 WARRANTY

PJ Tech cap lamps are warranted against defects in workmanship and materials for period of 12 months from date of delivery. This warranty does not cover failures due to misuse, neglect, abuse, improper handling, alteration, improper maintenance or accident, and PJ Tech shall not be liable for any direct, indirect, consequential or incidental damages from use, results of use or inability to use this product. Within the warranty period, the faulty product will be repaired or replaced by PJ Tech free of charge. Except as mentioned above, no other warranty expressed or implied applies.

9 DELIVERY

Cap lamps are delivered with disconnected microprocessor connector under the cover of the battery casing (Figure 1-3). The cap lamp package consists of the following:

- Complete Cap Lamp.
- Box.
- Operating Instructions Manual.

10 STORAGE

Cap lamps should be stored as follows:

- Humidity below 70%.
- Temperature between 10-30°C.
- Away from the source of heat and direct Sunrays.



11 SPARE PARTS

Group	NO	Description	P/N
Battery Casing	1	Battery Set	PCL-SM05-ELK-70.468
	2	Belt Bracket	PCL-SM05-ELK-20.128
	3	Casing Cover	PCL-SM05-ELK-70.470
	4	Seal	PCL-SM05-ELK-35.166
	10	Membrane Switch	Non-Replaceable
Cable	5	Complete cable	PCL-SM05-ELK-25.492/4
	16	Cable	PCL-SM05-ELK-25.578
	13	Cable entry sleeve	PCL-SM05-ELK-35.191
	14	Cable entry sleeve	PCL-SM05-ELK-35.192
	15	Washer	PCL-SM05-ELK-10.148
	15	Nut M18x1,5	PCL-SM05-ELK-10.147
Head Lamp	6	Head Lamp	PCL-SM05-ELK-72.605
	7	Threaded Cover	PCL-SM05-ELK-19.644
	8	Seal	PCL-SM05-ELK-35.167
	9	Protective Glass	PCL-SM05-ELK-34.025
	11	Reflector Set	PCL-SM05-ELK-70.454
	12	Head Lamp Clip	PCL-SM05-ELK-15.442

Table No.:4 – Spare Parts List

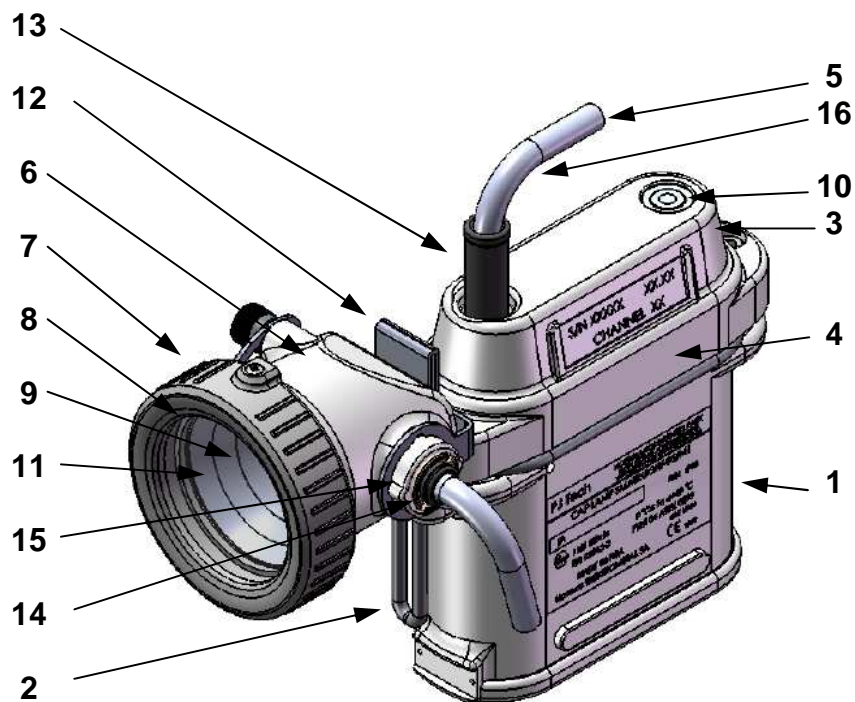


Figure No.:1 – Spare Parts – SMARTLIGHT-05/M1 CAP LAMP



12 HOW TO ORDER

The orders should be sent to the below:

Company Name	:	PJ TECH
Registration Number	:	CK94/30139/23
V.A.T. Number	:	4240179202
Contact Details	:	Tel.: +27 (011) 704-7088/9 Fax: +27 (011) 704-7019 e-mail: sales@pjtech.co.za www: www.pjtech.co.za
Physical Address	:	Northlands Business Park North Riding Johannesburg Republic of South Africa

When placing orders, please provide the below part number:

PCL-SM-05/M1