Mig134H Basic specifications:

Spot beam and wide-angle beam, each from its own highly efficient Luxeon III LED.

Ingenious 'Halflector' design allows the spot-beam LED to also provide down-light to illuminate the ground in front of the caver.

Wide-angle beam gives excellent, smooth, all-round illumination

Each LED has two operation modes - a simple two-power mode with high and medium settings, and an advanced mode with an additional low setting.

High:	1 Watt	(360mA)
Medium:	$^1/_3$ Watt	(120mA)
Low:	$^1/_{12}$ Watt	(30mA)

The '134' designation of the Mig134H describes the power output per LED - the first digit is the high power output, the second digit is the fraction of high power for the medium setting, the third digit is the fraction of the medium power available in the low setting.

Both LEDs and all the controller circuitry are mounted on a modified Oldham reflector, and can be fitted in Oldham and Speleo Technics headsets after the simple (and reversible) removal of a few components. Fitting involves just connecting 4 leads to connect to the headset, and swapping the power supply connections
Due to the design of the switching circuitry, and the necessary switching of polarity of power connections in the headset, the Mig134H is *not* suitable for use in charge-through-the-headset caving lamp systems, such as most lead-acid ex-mining lamps.

Each beam has entirely independent controller circuitry, and each power controller has redundancy built in for extra reliability.
In the further intersets of robustness, 3Watt Luxeon LEDs are used despite being driven at a maximum power of 1W per LED

Power control is via simple linear regulation for the high and medium power settings, and current-limited PWM regulation for the low setting.

Input voltage range 3.6-5.5V, allowing use of 3 or 4 NiCd/NiMH cells, (Headlite, FX3, etc) or 3 alkaline cells. (Use of 4 alkaline cells is not recommended - see 'battery life' section.)
Power consumption in 'off' mode is roughly 10nA per beam.

Although an FX3 (or similar) user desiring a very long-lasting light will find a Mig134
a good choice, the prime target user is someone requiring an efficient and versatile light for use with helmet mounted rechargeable or alkaline batteries. Expedition use with MN1203 or similar batteries was the design goal, with many days of caving possible on a single battery.

Operation of the Mig 134 caving light

The rotary switch in the headset is used to control both wide and spot beams, in a similar (though more complicated) way to operation with conventional incandescent bulbs.
The circuitry for each LED is entirely independent from the other, and connected to a different contact on the switch. To understand the lamp operation, it is best to consider only a single beam and its half of the switch. The other beam works in exactly the same way, but is controlled by the other half of the switch.

Each time the switch contact for a beam closes or opens, the beam will change state - either altering its power level, or switching off. The key thing to remember is that whenever the switch for a beam is closed, the beam will be at high power, and whenever the switch is open, the beam will be at medium or low power, or off. When this document refers to a *switch* being on or off, it should be understood that means the same as the switch being closed or open, and it does not referf to the state of the beam that switch is controlling.

<u>Simple Mode</u>
In simple mode, the basic cycle of a beam is:

Point in cycle	1	2	3	4	1 (again)
Switch	off	on	off	on	off
Beam	off	high	medium	high	off

As mentioned above, whenever the switch is on, the beam is at high power. If the beam is off, high power simply requires turning the switch on, whereas selecting medium power just needs the switch to be 'blipped' on and off. However, one problem with simply operating a beam in a 4-step cyle like this is that when the lamp is on, it isn't possible to know whether you are at point 2 or 4, and so whether opening the switch will set the beam to medium power or turn it off. Whan caving, it is useful to be able to change power levels while moving without uncertainties about the lights going out temporarily, so the operation was modified a little from the simplistic 1-2-3-4-1 sequence above.
Time was brought in as a factor such that the new rules of operation are:
a) If the switch goes from off to on, turn the beam on high power.
b) If the switch goes from on to off, turn the beam on medium power, *unless* the switch has already gone from on to off in the last 5 seconds, in which case, turn the lamp off.

This means that if the switch state is changed infrequently, the lamp alternates between high and medium power, without ever going out. If the switch is operated frequently, the operation is as the simple 1-2-3-4-1 cycle above would indicate.
To turn the lamp off, if the switch has not been operated for the previous 5 seconds it simply needs to be turned off->on->off (if beam is on high power) or on->off->on->off (if beam is on medium power), within a 5 second period.

<u>Advanced mode</u>
In advanced mode, a beam will again be at high power whenever the switch is on.

The beam will change from high to medium power, or from high to low power, on alternate on->off switch transitions. The effective cycle is high->low->high->medium->high->low, etc Turning the lamp off requires that the switch is moved from on to off *five* times in five seconds.

<u>Connecting your Mig134H</u>

Note - the 134H is not suitable for through-the-headset-charging headlamps (eg 4V lead-axcid Oldham lights)

Fitting into an Oldham headset requires the removal of the reflector, main beam conncting wire, and pilot bulb holder.

a) Disconnect the headset from its usual power source.

b) Open the headset.

c) Unscrew and remove every screw except for the two switch-contact retaining screws, the switch centre-contact screw, and the grub screw on the rotating part of the switch.

d) A Mig134 requires a positive voltage to operate the switch inputs. The standard wiring arrangement of an Oldham (or Speleo Technics) headset is for the switch to be on the negative side of the circuit. If the lighting system to which a Mig134 is to be fitted uses polarised batteries (ie batteries which can only be connected one way round), such as Headlite packs, the power leads inside the headset need to be reversed from their usual position, so that the positive input goes to the switch. In an Oldham headset, this means the positive lead (generally brown, possibly red) must be connected to the contact in the floor of the headset near the cable entry point (close to the contact for the rear of the main beam). The negative supply (generally blue, possibly black) must be connected to the two-screw-hole bar opposite the (removed) pilot-bulb holder. The positive (red) supply to the Mig134 has to share same screw as the positive supply input - this can be an fiddly connection to make, due to the stiffness of the wires.

In case of such stiffness, it can be useful to first screw the positive battery input to its new position without trying to connect the Mig134, and without fully tightening the screw. It is then possible to gently bend the positive wire so that it adjusts to its new position without excessive springiness. Once this is done, the connection can be unscrewed, and then both the battery and Mig134 positive leads fastened into position. Care should be taken that neither the battery input nor the Mig134 power connection are left in contact with either the negative feed running round the edge of the headset floor beneath the power input or the bulb-base contact running from the switch.

Users of only non-polarised batteries (eg 4.5V MN1203) could avoid swapping the incoming power cables around, and simply attach their batteries the 'wrong' way round in the battery case, but it is probably best to follow the procedure above

e) Connect the negative battery input to the two-hole bar

f) The negative supply for the Mig134 (black lead) should be connected to either the right-hand pilot bulb holder mounting hole, or the two-hole bar

g) The two white switch input leads should be connected, one to each switch contact. To do this, remove the screw from a switch contact, place the screw through the ring connector on the end of a (white) switch input lead, then place the screw through through the swicth contact mounting hole, and screw into the threaded hole in the headset base. Then fasten the other switch-input lead to the other switch contact. (Note - it does not matter which white lead is connected to which switch contact.) The ring connectors should be positioned so that they do not contact anything except the appropriate switch contact.

h) If not fitted already, a rubber sealing ring in good condition should be installed around the edge of the reflector. The Mig134 wires should be folded such that they keep to the right-hand side of the reflector when it is placed in the headset body (ie, away from the rotating switch contact), and then the reflector should be positioned in the headset with the wide-angle beam towards the top. The glass should be placed on the reflector, and the bezel aligned ready for tightening.
i) Since there is no pin to locate the Mig134 reflector in position and prevent it rotating during bezel tightening, pressure *must* be applied on the front of the glass during tightening to ensure that unwanted rotation does not take place.
j) Keep any leftover parts (relfector, pilot bulb holder, screws, etc) in case reversion to incandescent bulb use is desired later. Note that if polarity-sensitive parts (LED bulbs or reflectors) have been removed, and the incoming power wiring has been swapped, then it may have to be swapped back again in case of return to the original components.

Fitting in a Speleo Technics headset is similar to the above, though the parts to be removed (for example, the two-bulb-holder plate) to initially achieve an empty headset may be different, depending on the precise model.

Powering up your Mig134

It is best to power up your unit with the switch set in an open condition, so that neither lamp is on (read further for reason why). On connecting the battery, the power-up sequence will be initiated - both beams will flicker for ~4 seconds, hold steady for 1 second, and then extinguish. Both beams should be in simple mode, and it is advised you initially familiarise yourself with this mode. Since the LEDs are more than bright enough to leave temporary dark spots in your vision, it is best to practice using the light while it is mounted on a helmet, or otherwise pointed away from the eyes, and in a space sufficiently dark to enable the various power levels to be investigated..
Practicing *blipping* the switch - (quickly turning it from off to on and then back to off) is recommended. In a headset mounted on a helmet, this is probably easiest if the switch is in the off position such that turning the switch clockwise (top forwards) will operate the contact for the beam in question. To change levels on the wide-angle beam, it is best to turn the spot beam off, as an operating spot beam it may make comparison of the various wide-angle power levels diffcult.
To turn off a beam in advanced mode, as an alternative to five successive blips, it is worth experimenting with a *through* manouvre - from one off position to the other through the on position for the beam in question. Five through manouvres will turn the beam off

Switching from simple to advanced mode.

The default state for a controller circuit is simple mode. To access advanced mode, the switch for that beam needs to be operated during the power-up sequence, or set closed before the sequence starts. Due to the extremely low power consumption of the circuitry when a beam is off, a short time spent without power may not be noticed by a controller. This means that
a) If a beam is off when a battery is disconnected, it might not notice the power loss, and so it may carry on in its previous mode (simple or advanced) when power is resupplied. If this is the case, the beam will not perform its power-up sequence on battery reconnection.
b) If a beam is operating (on any power level) before a battery disconnection of significant

length, it will recognise the disconnection and enter its power-up sequence on reconnection.
c) To ensure that a beam starts up in simple mode after a battery disconnection (whatever its current mode), the beam should be set to medium (or low) power before disconnection, and not turned on during the power-up sequence.
d) To ensure that a beam starts up in advanced mode, it can be left on high power before disconnection. On reconnection it will enter the startup sequence, then immediately recognise that its switch is on, and so select advanced mode.
e) If you are in simple mode on both beams, and want to stay that way, ensure that neither beam is on at high power before battery disconnection, and do not rotate the switch during power-up. That way, whether or not one or both beams enter the power-up sequence, neither of them will enter into advanced mode.

It is probable that the Mig134 will be operated either
a) with both beams in simple mode, giving similar operation to a conventional two-bulb caplamp with the advantage of simple access to high and medium power settings,
or
b) with the wide beam in advanced mode, and the spot beam in simple mode. This allows for the wide beam to be left continually on low or medium power, depending on the amount of light desired, and for the spot beam to be easily turned on and off when needed for distance illumination.

<u>Low-battery warning</u>
In high or medium power, at the point when the battery becomes depleted to the point where it is not possible to sustain the selected power level (or shortly after if changing power levels to a power that is not sustainable by the battery), a warning will be given by the beam flickering for a few seconds. During this flickering, the beam is on most of the time, so it does not constitutre a hazard when caving. If in high-power mode, the beam will drop to medium power after the flickering, if in medium power, the beam will be left in a (declining) medium power after the flicker. Three flickering events will be performed per beam per battery, after which flickering will no longer occur when switching power levels, and even in high power mode, the beam controller will give as much power as possible, slowly declining down to medium power and beyond.

<u>Care of your unit.</u>
Whilst the circuitry is potted in resin, and is likely to temporarily fail safe even if water does penetrate, it is advised to avoid getting water in the headset, primarily because of the potential effect on the reflector silvering. If the headset does get water inside, it should be opened and allowed to dry thoroughly as soon as possible. Care should be taken not to touch or otherwise damage the reflector surface, as this may allow water to penetrate the laquer and corrode the metal reflective layer, impairing spot-beam performance. If the unit is to be fitted to a headset known to have leaked in the past, it is best to address the waterproofing issues of the headset before fitting the unit. Even ignoring potential problems with the reflector, the resin potting around the circuitry is intended to make it water resistant, not waterproof under serious pressure, and so use in diving lights is not recommended.

Contact: cavelights@potholer.com