



PAGlink™

PAG ™

V-Mount Intelligent Linking Batteries User Guide



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Thank you for choosing PAGlink V-Mount Intelligent Linking Batteries. Please read the important safety information and instructions before using your battery.

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1. Introduction

1.1 Models covered by these instructions:

PAGlink V-Mount

PAGlink V-Mount batteries are designed for compatibility with the Sony V-Mount specification. There is a choice between 96Wh and 150Wh capacities, and a choice between a 5-light and a numeric Run-Time & Charge Status Display.

Model	Name	Capacity	Display
9303	PAGlink PL96e	96Wh	5-Light
9304	PAGlink PL96T	96Wh	Numeric
9308	PAGlink PL150e	150Wh	5-Light
9309	PAGlink PL150T	150Wh	Numeric

- 1.2 The unique PAGlink system allows up to 8 batteries to be linked for charge or discharge, regardless of their rated capacity or their state-of-charge.
- 1.3 When linked, PAGlink batteries form a network that allows them to communicate with each other and report to the camera as one battery.
- 1.4 The PAGlink system will automatically select the most suitable batteries for discharge, according to their charge status. Batteries do not discharge into each other. The system ensures that the maximum linked output is kept to a safe level.



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Main Battery Contacts

- 1.5 PAGlink batteries can deliver a current of up to 12A when linked, using superior, high-current pin contacts.
- 1.6 PAGlink batteries can be hot-swapped to deliver continuous power, which means no more time-wasting camera reboots.

1. Introduction

- 1.7 All PAGlink batteries feature a display that provides remaining runtime for the total of all linked batteries, and state of charge for each individual battery.
- 1.8 The battery display maintains accuracy by tracking performance and adjusting calibration values to compensate for the ageing of the cells.
- 1.9 PAGlink batteries will automatically detect and adapt to a multitude of camera data systems to provide charge status information in the camera viewfinder/LCD.
- 1.10 Batteries of any rated capacity, in any state-of-charge, can be linked for charging, in multiples of 8 or less. During charging, the least-charged batteries are given priority. The charge status for each battery is shown on its own display.
- 1.11 The intelligent PAGlink batteries manage their own charging safely and efficiently, and can be charged, whilst linked, using other reputable manufacturer's Li-Ion chargers.
- 1.12 Power from the battery linking contacts can be accessed using the PAGlink PowerHub, an accessory power plate which provides multiple D-Tap outputs, (interchangeable with Hirose, Lemo and 2.1mm connectors) and a USB output.
- 1.13 PAGlink battery and charger firmware can be updated easily by the customer, via external contacts, using an update tool provided by PAG.

- 1.14 PAGlink Li-Ion batteries are tested by an independent authority to UN standards in compliance with IATA Air Transport regulations.



Micro Charger - World's smallest V-Mount multi-battery charger



PowerHub - Provides outputs to power camera accessories



PL16 Charger - 16 batteries charged simultaneously

2. Specification

2.1 Cell Technology: Premium-grade Lithium-Ion sealed rechargeable cylindrical cells.

2.2 Capacities:

Models 9303 & 9304:

Nominal 6.5 Ampere-hours (96 Watt-hours).

Models 9308 & 9309:

Nominal 10 Ampere-hours (150 Watt-hours).

2.3 Voltage: 14.8V nominal. 12 cells connected in series/parallel. Each cell has a nominal voltage of 3.7V.

2.4 Output Current: The rated maximum continuous output current for two or more linked batteries is 12 Amperes (8 Amperes for individual batteries).

2.5 Temperature Range:

Charging:

0°C to +45°C Optimum +10 to +40°C
+32°F to +113°F Optimum +50°F to +104°F

Discharging:

-20°C to +50°C Optimum +10°C to +40°C
-4°F to +122°F Optimum +50°F to +104°F

Storage:

+10°C to +30°C (+50°F to +86°F).

2.6 Dimensions (L x W x H):

133mm (5.2") x 84mm (3.3") x 50mm (1.9")

2.7 Weight:

Models 9303 & 9304: 726g (1.6lbs) approx.

Models 9308 & 9309: 770g (1.7lbs) approx.

3. Charging

3.1 IMPORTANT: READ THE CHARGER HANDBOOK BEFORE ATTEMPTING TO CHARGE THE BATTERY.

3.2 The following PAGlink chargers will charge PAGlink V-Mount batteries, individually or linked, regardless of their capacity or state of charge:

9707	PAGlink PL16 Charger	2-positions, 8 batteries on each
9711	PAGlink PL16+ Charger	4-positions, 4 batteries on each
9708	PAGlink Cube Charger	4-positions, 2 batteries on each
9713V	PAGlink Micro Charger	1-position, 4 batteries in total
9710	PAGlink Micro Charger	1-position, 4 batteries in total

The following chargers will charge PAGlink V-Mount batteries individually or linked (batteries must be within 40% state-of-charge of each other to be charged fully):

9702VR	PAG RMC4X Charger	4 positions, 4 batteries on each
--------	-------------------	----------------------------------

Constant-voltage V-Mount Li-Ion chargers of other reputable manufacturers are also suitable.

3.3 The batteries incorporate a temperature sensor which will inhibit charging if their temperature is below 0°C. See Section 2 Specification for the charging temperature range of PAGlink batteries.

3.4 Charge Times: Times given are for fully-discharged batteries to fully-charged, using a PAGlink PL16 charger.

1 x 96Wh battery	2 hrs	30 mins
2 x 96Wh batteries	3 hrs	
4 x 96Wh batteries	6 hrs	
6 x 96Wh batteries	9 hrs	30 mins
8 x 96Wh batteries	11 hrs	45 mins
16 x 96Wh batteries	24 hrs	
1 x 150Wh battery	3 hrs	45 mins
2 x 150Wh batteries	4 hrs	30 mins
4 x 150Wh batteries	9 hrs	
6 x 150Wh batteries	13 hrs	
8 x 150Wh batteries	18 hrs	
16 x 150Wh batteries	36 hrs	

3.5 PAGlink batteries display their individual charge status, during charging, on their built-in display. When using PL16 chargers, the characters of the numeric display can be inverted, for legibility, with a single button press. The display reverts automatically after removal from the charger.

4. Discharging

- 4.1 The batteries incorporate a precision fixed end-of-discharge cutoff set to 12.5V, as measured by the battery. This cutoff will only operate if the battery capacity is less than 5%, eliminating unwanted operation due to high current and low battery temperature.
- 4.2 The maximum continuous discharge current for a single PAGlink V-Mount battery is 8A. The batteries incorporate a current limit, and consumption above this for more than 5 seconds will trigger the over-current protection, turning the battery output off.
- 4.3 If the battery is discharged at too high a rate, even momentarily, the protection circuit may be triggered, disconnecting the battery output. It can be recovered by simply removing it from the load and pressing the display button, provided the battery still retains some charge.
- 4.4 Where total continuous consumption is above 8A, two or more PAGlink batteries should be linked. This will increase the maximum continuous discharge current to 12A, provided the batteries are in a similar state of charge.
- 4.5 The battery may be discharged within the temperature range -20°C to +50°C, but for optimum performance, +10°C to +40°C is recommended. The operating time will be shorter in conditions of low temperature, and discharging will be electronically inhibited if the battery temperature is below -20°C.
- 4.6 When the battery has been discharged at a high rate it will become warm, and it is advisable to let it cool before charging it.

4.7 Computer Reset

The battery features a computer reset function. In exceptional circumstances, a computer reset may be required. This is achieved by holding the display button in for 20 seconds.

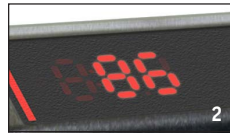
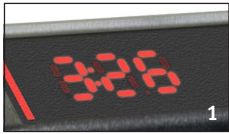
5. Storage

- 5.1 For the short term, PAGlink batteries can be left stacked on a charger until required; the charger will keep them topped-up ready for use.
- 5.2 For long-term storage, batteries should be in a half-charged state (between 20% and 80%), and unlinked. Storing batteries linked accelerates the rate at which they self-discharge.
- 5.3 After 2 weeks of inactivity, a PAGlink battery will automatically enter **Sleep Mode**, which greatly reduces its rate of self-discharge. It can be woken prior to use by pressing the display button twice, by linking 2 batteries or by connecting it to a charger.
- 5.4 Batteries should be stored in a cool, dry place at a temperature between +10°C to +30°C (+50°F to +86°F). Long-term storage outside of this temperature range may reduce the battery's life. Maintenance charging is not required during long term storage.
- 5.5 After storage it is advisable to fully-charge batteries before use.

6. Run-Time, Capacity & Data

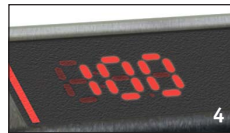
6.1 The Numeric Display:

The battery is able to display a numeric run-time prediction against load, and charge status as a percentage.



(1) When connected to a camera that is turned on, two presses of the battery's display button will show a predicted run-time against the given load, expressed in hours and minutes. When batteries are linked the run-time displayed relates to the **total** for the connected batteries.

(2) A single button press of the display, off or on-load, shows state of charge as a percentage. When the batteries are linked this figure still relates to the battery's individual state of charge.



(3) When battery state of charge drops below 5% the display will indicate that the battery should be charged as above.

(4) When the battery is fully charged the display will indicate 100%.

6.2 The 5-Light Display:

The battery is able to indicate a run-time prediction, against load, and charge status as a percentage.



(5) When connected to a camera that is turned on, two presses of the battery's display button activates the time display. The 'HRS' LED will flash twice.

(6) The number of hours will then be indicated by the number of lit segments: each light = 1 hour.









(7) The 'MINS' light will then flash twice.

(8) The number of minutes will be indicated by the number of lit segments: each light = 10 mins. When batteries are linked the run-time displayed relates to the **total** for the connected batteries.

6. Run-Time, Capacity & Data



(9) A single button-press, whether the battery is on or off-load, displays charge status in terms of percentage. When batteries are linked this figure still relates to the battery's individual state of charge. The lights indicate remaining capacity in percentage blocks:

	80 - 100% remaining
	60 - 79% remaining
	40 - 59% remaining
	20 - 39% remaining
	10 - 19% remaining
	1 Flashing = 0 - 10% remaining

6.3 In-Viewfinder Battery Status

Battery state of charge can be shown as a percentage in the viewfinder/LCD of cameras designed to accept this data. Different data standards are used by camera and battery manufacturers. PAGlink V-Mount batteries automatically adjust the data output standard to support SMB (Sony & Red) and I²C (IDX).

When the batteries are linked, the data displayed in the viewfinder/LCD is for the combined state of charge:

$$\frac{60\% + 40\%}{200\%} = 50\%$$

6. Run-Time, Capacity & Data

6.4 PAG Numeric Display Data Output

Data stored in the battery's microprocessor can be revealed using the battery display.



Press display button x3 in 1 sec intervals & hold for data mode



Release to see 1st menu item: 'Pd' (voltage)



Press & hold for 3 seconds to see voltage reading



Press without holding for 2nd menu item



Press & hold for temperature in degrees celsius



Press twice without holding for 3rd menu item



Press & hold for number of charge/discharge cycles



Press x3 without holding for software version



Press & hold for version number...



...which appears in 2 parts indicating version 5.7



Press x4 for computer reset

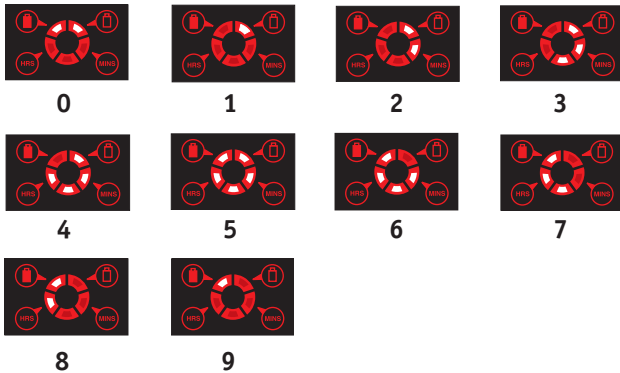


Press & hold to perform reset & do not release until 3 lines disappear

6. Run-Time, Capacity & Data

6.5 PAG 5-Light Display Data Output

Data stored in the battery's microprocessor can be revealed using the battery display. The display lights indicate numbers 0-9 in the following way:



Data Mode: press the display button 3 times, in 1 second intervals, and hold on the third press to enter data mode. All 5 lights will flash:



1. Percentage State of Charge



Release to select
1st menu item:
**Percentage State
of Charge**

Press & hold for
3 seconds to see
reading for % SoC.
This indicates 9...

...this indicates 5.
Therefore it reads
95% charged.

2. Temperature in degrees Celsius



Press once without
holding to select 2nd
menu item: **Tempera-
ture**

Press & hold to see
temperature in degrees
celsius. This indicates
2...

...this indicates 5.
Therefore it reads
25°C.

6. Run-Time, Capacity & Data

3. Number of Cycles (Charge/Discharge)

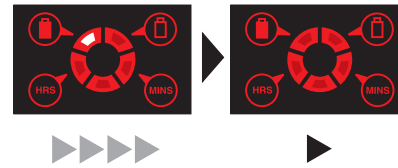


Press x2 without holding to select 3rd menu item:
Charge/Discharge Cycles

Press & hold to see number of cycles.
This indicates 3...

...this indicates 6.
Therefore it reads 36 cycles.

5. Reset Function



Press x4 without holding to select 5th menu item:
Reset Function

Press & hold to perform reset & do not release until all lights turn-off.

4. Software Version



Press x3 without holding to select 4th menu item:
Software Version

Press & hold to see version number.
This indicates 1...

...this indicates 9.
Therefore it reads Version 1.9.

7. Battery Protection Features

7.1 Over-charge Protection

Charging will be inhibited if the battery voltage exceeds a pre-set level.

7.2 Over-discharge Protection

When the battery voltage reaches 12.5V, discharging is inhibited.

7.3 Over-current Protection

If a single battery is subjected to a current greater than 8A, but less than 15A, the output will be turned off after 5 seconds. If the current is greater than 15A, the output will be turned off immediately. In either case, the battery display will be inoperative and there will be no voltage available at the terminals. The battery can be reset by removing it from the load and pressing the display button.

7.4 Thermal Protection

Software protection inhibits charging if the battery temperature is below 0°C. Return the battery to the charger when the battery temperature rises above 0°C.

Software protection inhibits discharging if the battery temperature falls to -20°C, or if it rises to +70°C. The output can be restored when the battery temperature becomes within the specified range by pressing the display button.

A thermal fuse is incorporated within the battery construction as a 'backstop' protection device, and this cannot be reset. In the unlikely event of this fuse operating, please contact PAG or your dealer.

7.5 Construction

The battery cases consist of high-impact injection mouldings, designed to protect the cells from impact damage.

The circuits are coated, making them resistant to electrolyte and ensuring the operation of the safety systems in the event of damage to the battery.

Internal wiring is rated for high current and high temperature, and is double-insulated for added safety and protection.

8. PAGlink Features

8.1 Linking Batteries:



Align the V-Mount connectors and push the battery down until you hear a click, indicating that the lock is engaged.

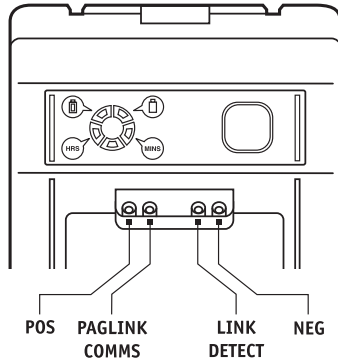


To release the battery, hold down the release button (1) and slide the battery up (2).

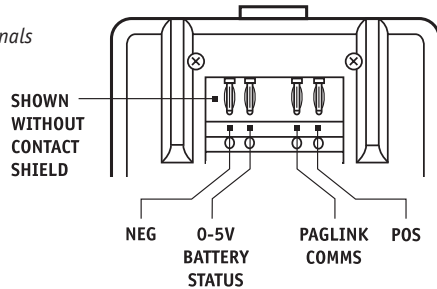
8. PAGlink Features

PAGlink V-Mount Terminals:

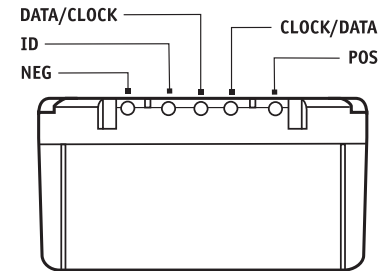
Front
Terminals



Rear
Terminals



Base Terminals



- 8.2 PAGlink batteries can be linked to combine their capacities, for example, two 96Wh batteries provide 192Wh, and 3 offer 288Wh. Two 150Wh batteries offer 300Wh when linked. Batteries of any rated capacity, in any state of charge, can be linked for charge or discharge. Linking batteries also increases the maximum continuous current draw capability from 8A to 12A, provided they are in a similar state of charge.

The maximum number of PAGlink batteries that may be linked has been limited to 8. If more than 8 batteries are linked, the management system will shut-down the supply, and no current will flow.

8. PAGlink Features

Linked batteries form a network which allows communication and ensures a safe protocol in all circumstances. The battery with one or more connected to its front contacts controls the delivery of current. This battery is always active, even when it isn't delivering current itself. The system makes the most efficient use of the power available, and prevents a transfer of charge between batteries.

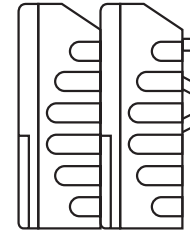
As discharge progresses, batteries are added to or subtracted from the bus bar to deliver the current required. **Linked batteries in a similar state of charge (within 20%) will discharge simultaneously, rather than sequentially.** Their individual state of charge and the total run-time can be viewed via their displays. **While there is at least one battery connected to the camera, other batteries can be added or hot-swapped in order to achieve continuous running.**

NOTE: When not in use, batteries should be kept in an unlinked state to ensure a lower self-discharge rate.

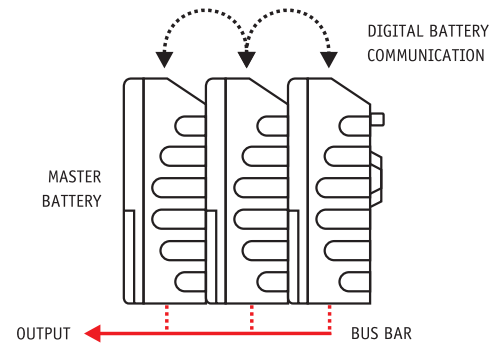
CAPACITY IN WATT-HOURS / MAX. CURRENT-DRAW IN AMPS



96Wh / 8A
150Wh / 8A



192Wh / 12A
300Wh / 12A



9. Safety Information

9.1 PLEASE READ THESE IMPORTANT SAFETY INSTRUCTIONS BEFORE USING THE BATTERY AND RETAIN THEM FOR FUTURE REFERENCE.

When used correctly, Lithium-Ion batteries are a rugged and safe method of storing power. However, incorrect treatment of the battery could present a hazard. In the interest of safety, and the protection of our environment, please read and observe the following health and safety information.

WARNING:



Do not drop, throw, puncture, crush or incinerate the battery. Severe mechanical abuse of the battery could result in damage to the cells, and short-circuit internal to the battery. Li-Ion cells can deliver power at very high rates. Arcing, excessive heat and the liberation of combustible gas could result, with the potential for personal injury or ignition of adjacent flammable materials.

Do not short-circuit the battery.

Keep the battery away from fires, strong sunlight and excessively hot environments.

Avoid getting the battery wet and do not use it if it has been immersed in water.

Do not attempt to disassemble the battery. Refer faults to authorised service personnel.

Do not continue to use the battery if there is any change in the appearance of the casing.

CAUTION:



The battery electrolyte is an alkaline solution, which can cause chemical burns to human tissue. Leakage can occur as a result of severe damage to the battery. Wear protective gloves when handling all contaminated materials. In the event of contact with the skin, flood copiously with clean water. If significant amounts of electrolyte are involved, or if any has touched the eyes, seek immediate medical attention.



ELECTRIC SHOCK: This symbol appears where the information relates to the risk of electric shock.



WARNING: This symbol appears where the information relates to an issue of personal safety.

10. Servicing

- 10.1** The PAGlink V-Mount rear latching mechanism is separate to the sealed battery case and can be replaced by the user in the event of damage. Parts and instructions can be obtained from PAG Ltd. or an authorised PAG Service Centre (listed at the end of this section).
- 10.2** Customers should not attempt to open the battery case for repair or any other purpose. Unauthorised servicing invalidates the battery guarantee and its air safety status (IATA).

If a fault develops, please contact your nearest PAG Service Centre to receive a fault diagnosis, which can be carried out over the phone, via a video call or via email.

Batteries that require further analysis must be returned to your nearest PAG Service Centre. Li-Ion batteries are classified as dangerous goods and cannot be returned without prior contact. Please provide the serial numbers of the batteries you are returning for servicing in advance.

The battery may need to be returned to the UK Service Department for repair. After investigation, it will be classified as either: a warranty repair (WR), a chargeable repair (CR), or beyond economic repair (BER). This will be communicated to the customer in a service report, along with an estimate of the cost of repair, before any work is undertaken.

It is PAG's policy to repair its batteries, in keeping with 'the right to repair', unless it is uneconomic for the customer to do so. Circumstances that make a battery beyond economic repair include physical

damage to the cells or a combination of low battery capacity and a damaged case. In these circumstances the cost of the repair would be better put towards a new battery.

If the battery is BER and you would like it returned, you must communicate this to the PAG Service Centre. If possible, batteries should be marked with a sticker that says "to be returned to the customer" before they are sent for servicing.

If the battery is BER and there is no indication that it should be returned, PAG will ask the customer when it submits the servicing report.

If PAG does not receive instruction from the customer after 6 months from the date of the report, the battery will be sent for recycling.

Please be aware that PAG is only able to return batteries that are legally safe for shipping. Batteries that have damaged cases as a result of being dropped, water-damaged batteries and batteries that have damaged cells cannot be returned.

Authorised PAG Service Centres:

UK & RoW: PAG Ltd.

Epsom Downs Metro Centre, Units 9 & 10, Waterfield, Tadworth, Surrey KT20 5LR, United Kingdom

Tel: +44 (0)20 8543 3131

Email: support@paguk.com

10. Servicing

The Americas:

PAG America (a division of the Carr Distribution Group)

18 Center Street, Ramsey, NJ 07446, USA

Tel: +1 631 300 8215

Email: sales@pagamerica.com

11. Recycling

- 11.1** Do not dispose of batteries or cells in a charged condition. Expired batteries should be disposed of in accordance with the appropriate regulations or legislation.

PAG offers a recycling service for its expired batteries in the UK. They can be returned to PAG Ltd. only by prior arrangement. They must be in a discharged state, and clearly marked "FOR RECYCLING".

Please do not attempt to return Li-Ion batteries for recycling without first contacting an authorised PAG Service Centre.

12. Guarantee

12.1 Notwithstanding any provision of any agreement the following guarantee is exclusive: PAG Limited guarantees each PAGlink battery it manufactures to be free of defects in material and workmanship, under normal use and service, from the date of purchase, for the period indicated below:



PL96 Models 9303 & 9304



PL150 Models 9308 & 9309

This guarantee extends only to the original purchaser. This guarantee shall not apply to fuses or any product or parts which have been subject to misuse, neglect, accident or abnormal conditions of operation.

In the event of failure of a product covered by this guarantee, PAG Limited will repair and calibrate equipment returned to an authorised Service Facility within the period of the guarantee, provided the guarantor's examination discloses to its satisfaction the product was defective.

The guarantor may, at its option, replace the product in lieu of repair. With regard to any equipment returned within this period, said repairs or replacements will be made without charge. If the failure has been caused by misuse, neglect, accident or abnormal conditions of operation, repairs will be billed at a nominal cost. In such a case, an estimate will be submitted before work is started, if requested.

The foregoing guarantee is in lieu of all other guarantees, express or implied, including but not limited to any implied guarantee or merchantability, fitness or adequacy for any particular purpose or use. PAG Limited shall not be liable for any special, incidental, or consequential damages, whether in contract, tort, or otherwise.

13. Air Transport Regulations

13.1 Compliance with IATA Dangerous Goods Regulations

All PAG Li-Ion batteries comply with the International Air Transport Association (IATA) Dangerous Goods Regulations, Section 2.3.5.9, which state that Li-Ion batteries must be tested in accordance with the UN Manual of Tests and Criteria, Part III, subsection 38.3, and manufactured by a company that has been approved to an internationally recognised standard such as ISO 9001:2015.

PAGlink Li-Ion batteries have been independently tested and approved by Intertek Group PLC to comply with UN Standard 38.3.

Models 9303 & 9304:	Test Report No. 11054580
Models 9308 & 9309:	Test Report No. 102617072

Copies of the test certificate and report can be obtained from PAG.



Each PAG Li-Ion battery is labelled with the test report number applicable to that battery design:



PAG has been assessed and approved by QAS International to the standard ISO 9001:2015

13.2 Advice for Travelling by Air with Li-Ion Batteries

Li-Ion batteries cannot be transported in the hold unless attached to a camera. Spare Li-Ion batteries **MUST** be carried in your hand luggage.

YOU CAN carry-on up to 20 spare Li-Ion batteries that have capacities of **100Wh or less**, however, the operator is the final arbiter.

In addition **YOU CAN** fly with two Li-Ion batteries that have capacities **greater than 100Wh, but less than 160Wh**, with the approval of the operator.

YOU CANNOT fly with Li-Ion batteries that have capacities **greater than 160Wh**. These are **FORBIDDEN** from passenger aircraft, unless a state exemption has been obtained (ie CAA/FAA operator).

Batteries **DO NOT** need to be discharged to **30% state of charge** for transport as personal luggage, this is a requirement of **cargo shipments only**.

It is advisable to keep the batteries in separate plastic bags and to bring with you copies of the UN test certificate and UN test report.

Since the interpretation and application of regulations may vary with each aviation company, PAG advises that you contact the carrier prior to travelling.