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SAFER WINTER FLYING

DRONE EDUCATIONAL & SAFETY ARTICLES

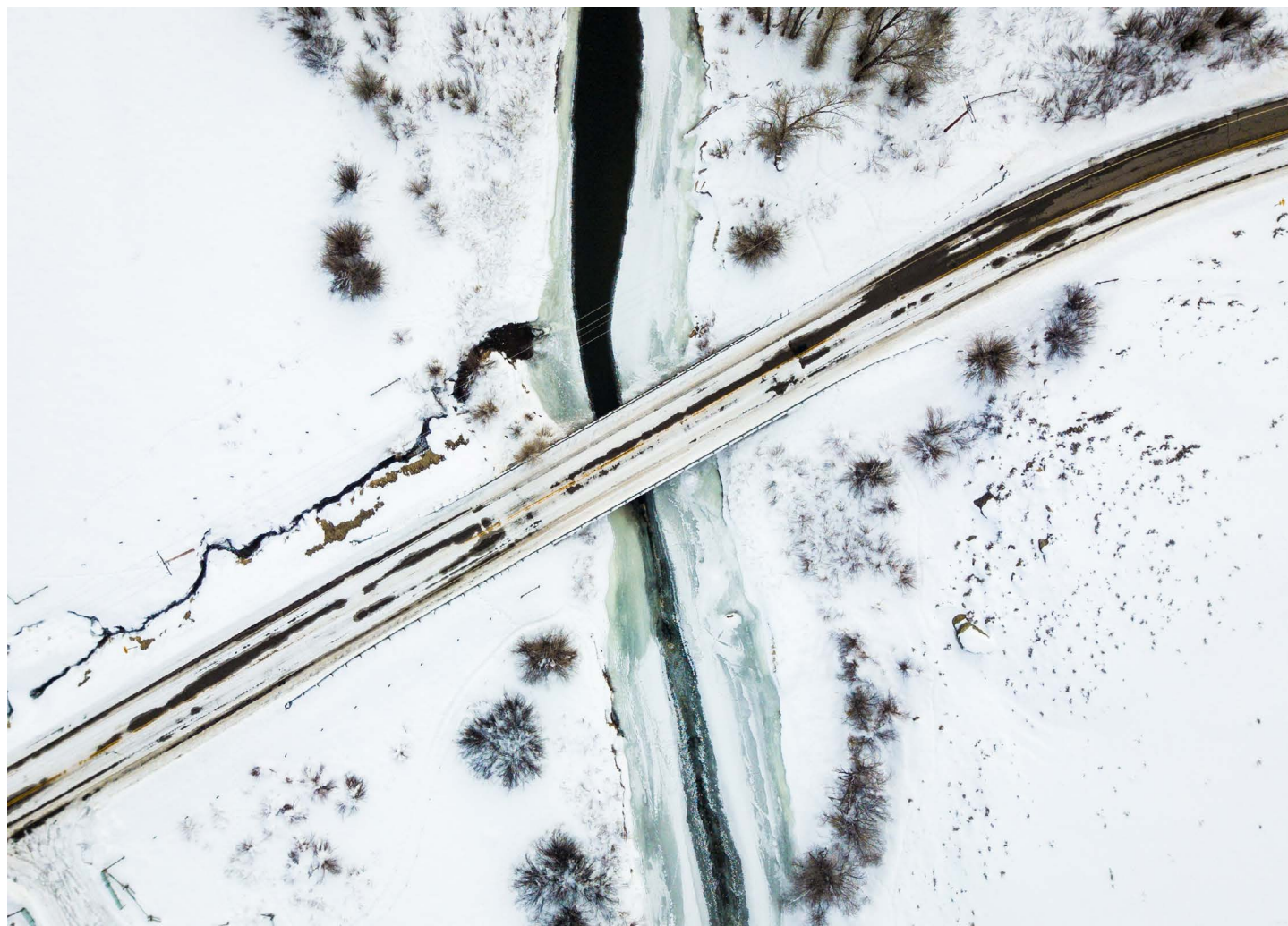
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INTRODUCTION

When the weather allows, winter flying in the UK can provide some of the best conditions for drone pilots. Superb visibility, still air, great light, and stunning visuals of mists, frost, and snow cover just some of the reasons to get out and get airborne on a bright and crisp winter day.

Most commercial operators will be familiar with the potential performance impact that lower temperatures can have on lithium battery chemistry. Indeed, data from analysing Mandatory Occurrence Reports (MOR) shows that, on average, aircraft failures and/or damage reports relating to battery issues triple in frequency from December to February each year. However, incidents have also been reported where other factors related to cold weather and winter flying have been the culprits.

In this article, we'll examine some of the increased or additional risks you may see in winter operations and how accounting for these in your planning and flying could lessen the likelihood of a costly accident.



BATTERY PERFORMANCE

Lithium batteries perform optimally within a given temperature range. For most batteries, this will be between 0°C and 30°C, but you must verify the manufacturer's specification for the battery packs that you use. These performance ranges may differ across different battery packs, even from the same manufacturer.

Temperatures below the optimum operating range cause the activity of the lithium ions inside the cells to reduce, shortening the expected operating time and/or delivering less power. Several MORs have highlighted aircraft failures in flight due to sudden, unexpected battery warning notifications followed by a rapid decrease in available power. This has led to uncontrolled auto landings in unsuitable areas and even complete loss of power to aircraft, which have fallen to the ground and been destroyed or seriously damaged.

Always allow for an additional margin of safety on your flight times when flying in cold conditions. Be prepared for low battery warnings to appear sooner than you might expect, and never ignore them or assume they are wrong based on your warm-weather operations. Cold temperatures can highlight battery faults - such as imbalanced cells - that did not cause any issues during the summer. Always charge your cells per the manufacturer's instructions using approved chargers and ensure the cells are balanced.

Many lithium cells may have a different optimum temperature range for charging, often higher than that for optimum discharge performance. In some cases, repeated charging in temperatures below the manufacturer's specifications can lead to permanent battery damage and reduced capacity. This could require the purchase of expensive replacement batteries before the expected number of charge/discharge cycles.

Finally, many operators endeavour to keep their charged batteries warmer than ambient temperatures before they are needed by storing them in a coat pocket. Be extremely careful not to accidentally place them next to metallic objects (such as keys) that could short the batteries out, risking a fire. If you do pre-warm batteries this way, consider placing them in a fire-proof battery bag before putting them inside clothing.



AIRCRAFT SYSTEMS AND PERFORMANCE

Perhaps less well-recognised are some of the effects of low temperatures and winter conditions on other aspects of your aircraft and associated systems.

All manufacturers will state an approved temperature range within which their aircraft should operate. Crucially, this may differ from the operating range for battery packs. Do not assume that temperatures suitable for your aircraft to operate are also suitable for the batteries and vice versa.

Similarly, check the approved operating temperature range for any controller or other electronic accessories - many of which may also contain lithium batteries. If you use a mobile device as part of your control system, be aware of the risk of much-reduced battery life or even a sudden unexpected shutdown should your phone or tablet become too cold. This could leave you in a position with no flight data, location information, or drone battery status available to you while airborne.

In cold temperatures, plastics can become brittle and more easily damaged. Small, previously insignificant cracks can rapidly grow when exposed to flight vibrations in cold weather. Pay particular attention to the condition of any flight-critical plastic components, including props, landing legs, and battery mounting points.

Solder joints can also weaken in the cold, causing the increased risk of failure of any "dry" joints that were previously unnoticed. Wires bringing power and/or data to any externally mounted accessories may be particularly vulnerable, as may externally mounted battery connectors.

Condensation can be an issue in winter flying. Taking a drone straight from a warm vehicle into dry, sub-zero air outside could cause condensation inside the aircraft that may impact internal electronics and fogging of cameras and lenses. It may be best to allow the aircraft to acclimatise for a few minutes before taking off if moving it between extremes of temperature and humidity.

High air moisture levels can attenuate radio signals - particularly in the 2.4GHz and 5.8GHz ranges that are commonly used by drone systems. If you are operating in high humidity conditions - typically early mornings in winter when there may be lingering mist or fog - be prepared for a potential reduction in the usual downlink range you may expect.



HUMAN FACTORS

Human factors should always be part of your planning and risk assessment whenever you fly. In the first article in this series (available at [caa.co.uk/drones/safety-advice-and-reporting/safety-advice-publications](https://www.caa.co.uk/drones/safety-advice-and-reporting/safety-advice-publications)), we saw that Human Factors are responsible for over 30% of Loss of Control incidents reported. Flying in winter can exacerbate some factors that may cause us to miss vital steps or perform in a way that increases the chance of an accident.

Don't underestimate the impact of being cold on our ability to fly. The most obvious way this can impact us is through our bodies' physical response. Shivering with cold can make precise control inputs difficult, if not impossible. While some people may try and mitigate the shakes by using a "pinch grip" on their control sticks rather than "thumb-on-top", a better approach is to ensure you are well dressed for the conditions. Keeping yourself at a comfortable temperature will help your performance physically and mentally.

Be wary of flying without gloves. Most of us prefer not to use them - either because they reduce the "feel" on the sticks or because it makes operating touch screens difficult and cumbersome - but in freezing conditions, your fingers can quickly become numb and lose the sensitivity you may need to get out of a tricky flight situation with manual input.

Finally, winter flying can bring additional performance pressures. The reduction in flyable days due to typical seasonable weather - and the reduced daylight hours available when the weather eventually cooperates - can lead to increased pressure to get out, get airborne and get the job done. Try to recognise when external pressures may come into play and allow for them in your planning and flying. Be alert to the risk of reduced vigilance and the potential for corner-cutting if you have a tight deadline and a narrow window of opportunity in which to make it. Allow plenty of time for travel and setup and increased breaks to allow crew and equipment to "defrost". Be realistic with timescales and manage client expectations before starting the job.



