🏠 **Directory**

Ricardo Rail

PanMon: Pantograph Condition Monitoring

For a frustrated passenger on the platform, news that services are suspended due to 'damage to the overhead wires', is the most heart-sinking of all.

Where 'signal failures' offers hope services could resume shortly, and 'broken down train' leaves open the potential that a replacement is on its way, damaged wires suggest long delays. By instinct, passengers suspect they won't be completing their journey today.

As passenger disappointment frequently festers into frustration, the question of "Why can we not avoid such incidents" appears in thoughts, complaints and increasingly social media feeds.

To some extent, we can.

Wear and Tear

Over time, damage to the overhead line equipment (OLE) is, of course, inevitable. There are many causes, with weather, such as high winds or extreme heat, being the most obvious.

Another significant cause of damage is defective pantographs.

A damaged pantograph – particularly one with degraded contact strips (the carbon surface that contacts the copper wire), can inflict significant wear and damage to OLE apparatus. In extreme cases, it can cause a tear-down of the wires. For vehicles travelling at speed, the damage can extend for many hundreds of metres, with repairs taking many hours or in some cases days.

On average, the UK railway has one 'dewirement' per month, with each incident's cost estimated at around one million pounds, and considerably more at major junctions.

Gaining the ability to identify defective pantographs and quickly remove them from service can deliver significant benefits to operators, infrastructure managers, passengers and freight.

Predict and Protect

PanMon is a remote condition monitoring system from Ricardo providing fully automatic, real-time condition assessment of in-service pantographs.

Like other products in the Ricardo intelligent rail monitoring suite, such as InfraMon and CatMon

(which monitor for track or catenary issues), PanMon provides a continuous feed of real-time diagnostics without interrupting service.

Used in the UK, Europe, Australia and Africa, PanMon scanners are positioned above the overhead wires to capture 3D laser scans and images of each pantograph on every passing train.

PanMon captures high-definition images at 3,000 frames per second, meaning even trains travelling at high speeds have their pantographs captured in detail.

Concurrently, lasers scan the full width of the pantograph, building a three-dimensional model, used to measure symmetry, roll, pitch, yaw and the integrity of the carbon contact strips.

The scans are digitally stored in the cloud by our Danish technology partner PantoInspect. The images and scans are analysed for chips and defects, damage to the end-horns, and wear of the contact strip. A customised dashboard relays analysis to maintenance teams, with any issues highlighted. Should specified thresholds be breached, an alarm is raised. Accessible data for each pantograph includes high-resolution images, a 3D model and

Background Image: PanMon installed near Braidwood, Scotland
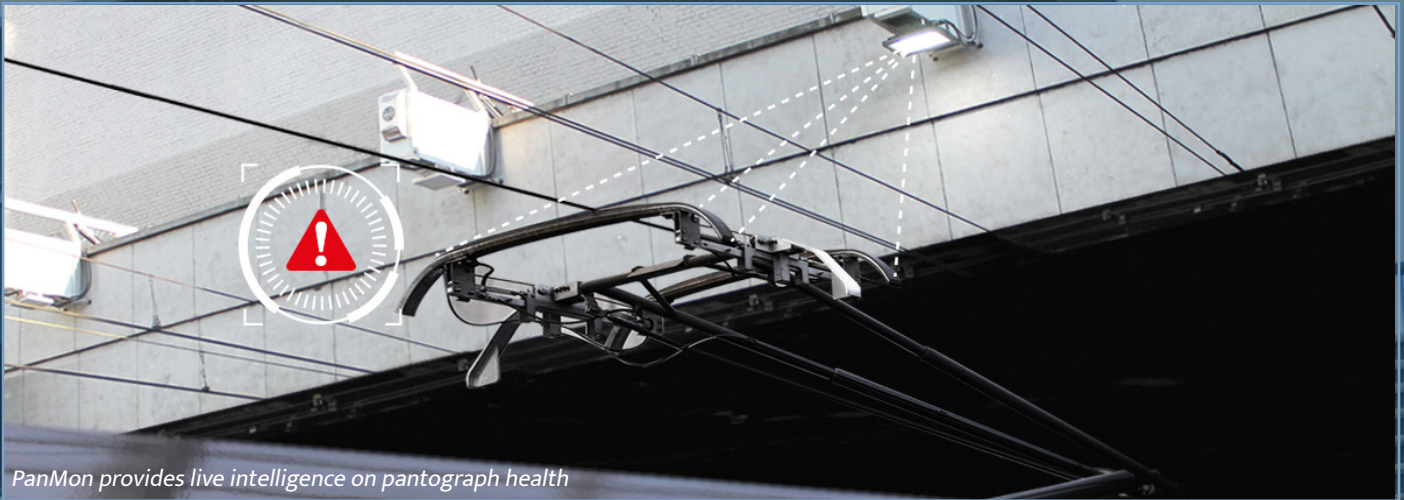
PanMon provides live intelligence on pantograph health

imagery of the entire train roof. Any defective units identified can then be prioritised for maintenance (minor fault) or withdrawn from service (major fault). These timely interventions avoid damage to both vehicle and infrastructure, delivering a more reliable railway.

Scotland's PanMon Systems Delivering 99.5% Accuracy

In 2019, Network Rail Scotland commissioned Ricardo to install fourteen PanMon scanners to increase railway system reliability and route availability.

Units were positioned on some of Scotland's busiest routes, including the East and West Coast lines, Edinburgh-Glasgow, North Clyde and Stranraer. Each active pantograph is inspected as the vehicle passes a PanMon scanner. The scanners capture data at a frequency far exceeding the capability of traditional inspections, together with avoiding the time, costs and hazards of electrical isolations and working at height. Each line-speed inspection takes just a fraction of a second and

detects issues before they result in damage and delays. On these routes PanMon keeps watch.

Identifying optimum locations to install PanMon scanners, ensuring the equipment is positioned safely – without obstructing day-to-day operations – is only part of the challenge. The critical factor, as far as maintenance teams are concerned, is accuracy. A system that misses too many emerging faults offers limited value. As would one that reports too many false positives.

To ensure the system met expectations, Ricardo's teams maintained close watch of PanMon's performance during its initial operation, making minute adjustments where required.

Within a few months, average accuracy exceeded 99.5%, with 50,000 pantographs being scanned and analysed each month.

Expert Support

Condition monitoring is not new, but it has come far. As accuracy approaches near-perfect, analytics are laser focused on the needs of

the user – no longer the deluge of data that can overwhelm and veil valuable insights.

Of course, no single solution can safeguard all infrastructure from all risks. But, as PanMon in Scotland shows, there are proven and reliable technologies that can make a real difference.

PanMon delivers efficiencies that payback in terms of safety, network resilience, route availability and, ultimately, cost savings.

For the stranded passenger now frantically making alternative plans, they are worth every penny.

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