

**PANDROL**

Making connections that  
drive rail forward

# TRACK REPORT 2024



## The Line of the Future

REVOLUTIONISING OUR PRODUCTION  
AND MANUFACTURING

INSIDE

### Introducing i+weld

YESTERDAY. TODAY.  
TOMORROW.

### Noise & Vibration

EXPERT SOLUTIONS,  
PROVEN RESULTS

### Sustainability at Pandrol

ON TRACK TO REACH  
CARBON GOALS





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# Welcome

## TO THE 2024 TRACK REPORT FROM PANDROL.

Ever since Clarence Léon Delachaux founded his transport infrastructure company in 1902, innovation has been an undeniable part of Pandrol's history.

Today, as we unveil i+weld – the latest evolution of rail welding, supported by our wealth of practical experience in aluminothermic welding and new technology design – it is clear that innovation is still the beating heart of this organisation.

This year's Track Report is full of similar stories of innovation. The Line of the Future project is particularly interesting. Set to transform the way we manufacture, this novel approach to optimising technology for our production line is currently taking shape. We hope that these advancements will have ripple effects not only for our own business, but for the industry as a whole, as we continue to lead from the front with pioneering solutions.

As for progress towards sustainability, it is only through innovation that we can really drive our decarbonisation goals forward. This applies not only to ground-breaking products such as our E+ range, or our Sustainable Resilient Systems (SRS) which utilise recycled

rubber for enhanced noise & vibration mitigation, but to internal processes, too. A new internal initiative empowers each of our sites to propose carbon reduction ideas as part of a fantastic way to keep our culture of innovation alive.

I am extremely proud to lead an organisation defined by world-leading product development and technical expertise. Our new On-Track 2028 vision is clear:

“

To shape sustainable rail infrastructure with innovative solutions.

”



Thank you to all of those who join us on this journey.

Nicolas Groult, CEO



# Pandrol On Track to Meet Sustainability Targets



MURIELLE KIEFER  
SUSTAINABILITY MANAGER

### PROGRESS TOWARDS OUR DECARBONISATION STRATEGY

Pandrol's history with sustainability is a long one, but this year in particular has been an exciting time for progress towards our goals. Our new 'On-Track 2028' strategy fully integrates sustainable development, making sustainability a key contributing factor to our shared success.

We are already making strong progress towards our 2030 targets:

- To reduce scope 1 and 2 carbon emissions by more than 42% compared to our 2019 baseline
- To reduce scope 3 emissions by 25% compared to our 2023 baseline

Our goals are underpinned by detailed roadmaps which lay out what we need to do to reach our targets, with monthly reviews and assigned GhG ambassadors.

We are working on continually reducing the energy consumption of our operations, and converting to green energy sources through driving process efficiencies, electrifying equipment, installing solar panels, or purchasing guarantees of renewable origin.

### CREATING A CULTURE OF COMMITMENT

Sustainability is now within the very fabric of our organisation – embedded through internal training, education, and our new strategy and core values. All colleagues are empowered to contribute to our efforts, supported by a new initiative which allows sites to propose ideas that will reduce CO<sub>2</sub>. These ideas are then reviewed by an internal committee which selects the projects that are most likely to benefit from ringfenced sustainability funding.

Over the last two years, I have been delighted with the positive progress that Pandrol has made in putting CO<sub>2</sub> firmly on the agenda.

### ENGAGING OUR ENTIRE SUPPLY CHAIN

This year was our second time calculating a full measurement of our scope 3 emissions and the results were revealing. A huge proportion of our carbon footprint – 63% to be exact – comes from goods and services from suppliers. It's vital that we view our supply chain as one ecosystem which needs bringing together in the same direction. After all, we cannot achieve real progress in isolation.

Last year we issued a CO<sub>2</sub> questionnaire to our suppliers as a way of developing their commitment and have since been questioning and reviewing their results, action plans and decarbonisation targets. In October we are holding a Supplier Day for 30 strategic suppliers where we will invite them to sign a decarbonisation engagement letter.

### LOOKING AHEAD TO THE FUTURE

We are confident that, however ambitious, we will reach our 2030 targets. But this milestone will not mark the end of the track. Looking to 2050 and beyond, a whole new business model will have to evolve in order to meet our long-term goals. We are already making plans to shape our future strategy, for instance we have now carried out our first double-materiality analysis to prepare for the upcoming CSRD European regulation. In this ever-changing climate, one certainty is clear: Pandrol has the dedication, innovation, and courage to be a business built for future success.

## Designed with circular economy in mind

In every product we investigate the possibility of reducing our impact on the environment, for example by decreasing material needs or increasing our usage of recycled material. Much of our product portfolio is independently covered with Environmental Product Declarations (EPD) which quantify the environmental impact of our products. Our E+ range in particular optimises energy-efficient, environmentally-friendly track construction and maintenance without compromising power.

### CD100 B: EMISSION-FREE INNOVATIONS

As part of Pandrol's E+ range, the CD100 B allows clipping machines to go emissions-free.

Powered by battery, this emissions-free portable clipping machine is designed for quick and easy clipping and declipping of the Pandrol FE, FC and FCX Fastclips. Compact and lightweight, the CD100 B is suitable for use by a single operator and can be easily carried onto site with its modular conception, saving time and labour costs.



### SUSTAINABLE RESILIENT SYSTEMS (SRS): NOISE & VIBRATION MITIGATION

As a leading provider of Sustainable Resilient Systems (SRS) based on recycled rubber technology, we provide solutions for rail networks across the globe for noise & vibration control and embedded rail systems, offering the lowest CO<sub>2</sub> footprint on the market.

Included under the SRS banner are the Floating Slab Mats (FSM), the Under-Ballast Mats (UBM), Under-Sleeper Pads (USP) and the FTrack and QTrack® embedded rail fastening systems.

Pandrol's Under Sleeper Pads (USPs) are made from end-of-life tyres, using around 2.3kg per sleeper, producing a carbon footprint that is less than half of the same product made using virgin material. Every kilometre of railway track installed with Pandrol's Under Sleeper Pads, saves 3,000 tyres from landfill or burning.



## THE EPD PROCESS

### LIFECYCLE ANALYSIS

All elements are considered for a detailed lifecycle analysis, from the collection of raw materials, through production, to transport to the customer.

### THIRD-PARTY SPECIALISED AUDIT

Auditors work with Pandrol to collect data relating to all stages of the product lifecycle. Real-life examples of manufacturing and shipping to customers were used.

### PUBLIC REPORT AVAILABLE

The EPD report is available for everyone to download from the EPD library. The report details the full process for collecting the data and the findings for each stage.

### REAL DATA OF PRODUCT LIFECYCLE

The data is used to measure the impact of each stage of the product's lifecycle on the environment.

### CARBON FOOTPRINT SCORE

Environmental impact and carbon usage at each stage is used to populate an impact report and give each product a comparable carbon footprint score.



# The Line of the Future



Tom Williams, Head of the Fastening Manufacturing Excellence Centre in Worksop, updates us on the Line of the Future project, which is set to transform the way we manufacture.

As a business, Pandrol is committed to leading the way in maximising technology to provide exceptional quality, cost effectiveness and sustainability. By investing in new technology, we are investing in the future of our business and the rail industry.

We are proud to have offered our customers cutting-edge, high-quality products for almost a century. Now, we want to harness new technology to make a step change in our production processes and ensure that we meet customer demands even more effectively in the future.

The Line of the Future project was conceived in late 2023 as a key part of bringing Pandrol's On-Track 2028 vision to life:

“To shape sustainable rail infrastructure with innovative solutions.”

The project has got off to an exciting and extremely productive start. Our aim is to have a fully costed concept production line ready by the end of this year, with a view to moving forward towards implementation of the Line of the Future in 2026.



## LEARNING AND OBJECTIVES

A key focus for the first half of this year has been evaluating our current manufacturing processes. This has included looking at indicators such as specific power consumption on a machine-by-machine basis, costs for procurement and install, maintenance requirements, and overall efficiency. From this data, we are creating a benchmark for each process and challenging fundamental aspects of what we do – encompassing everything from the forming methods we use and how we finish our products, to the type of steel we use globally.

We are using these findings to inform a full design for manufacture approach, integrating all our chosen systems. Our focus is to create a Line of the Future with the following features:

- Automated
- Digitised
- Quick changeover
- Fast cycle time
- Low cost
- Operational equipment effectiveness of 85%
- Embedded Lean tools
- Low carbon emissions

We have already delivered some early-stage concepts and are now building physical prototypes and testing as many ideas as possible to inform our final implementation plan. Every process involved in the new production line will be optimised to ensure minimum power consumption and footprint whilst maximising up-time.

Here's a quick snapshot of progress to date in two key areas: digitisation and forming.

“We want to harness new technology to make a step change in our production processes and ensure that we meet customer demands even more effectively in the future.”



## DEVELOPING DIGITISATION

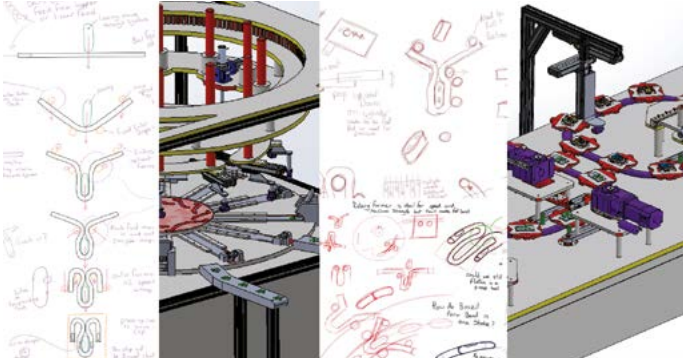
The Line of the Future will be fully digitised through a new Manufacturing Excellence System (MES), allowing ease of monitoring and control via a common standard, with planning and quality built in. MES will provide standardised production tracking, maintenance schedules and work orders. Using AI data analytics will provide us with a global predictive maintenance model, allowing us to pre-empt breakdowns and mitigate against machinery failures.

With system development moving on rapidly, plans are already in place to roll out MES this year in some of our current factories, including non-fastening production sites. As a digital solution, we are confident that this new system will make a significant impact on manufacturing excellence across all our operations and regions.

## FUTURE FORMING

The hot metal forming of a Pandrol clip is our core technology. It's where we have unique expertise and offers the greatest opportunity for a step change.

For the Line of the Future, we want to completely rethink our forming process, developing a new machine capable of producing FC, FD, FE and SD clips by 2026, with other clip types to follow. The images below show one such concept (since rejected), which involved the clip moving along a conveyor and being formed at the same time.



**Watch this space!**  
Whichever direction the Line of the Future takes, we are excited to see how it shapes the future journey not only of Pandrol, but also our customers and the rail industry globally.



# i+weld: the future of rail welding

Launched at InnoTrans 2024, the i+weld is set to revolutionise aluminothermic welding.

## THE CURRENT STATE OF PLAY

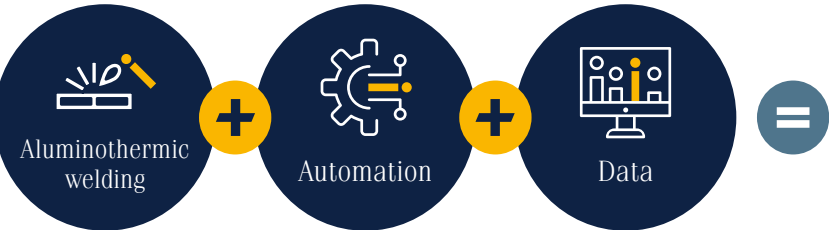
Aluminothermic welding (ATW) offers a cost-effective and flexible solution, but relies heavily on skilled welders, who are increasingly scarce due to a labour shortage in the rail industry.

Flash butt welding (FBW) offers high productivity, but requires substantial financial investment and is only sustainable for large-scale projects.



## PANDROL'S INNOVATION

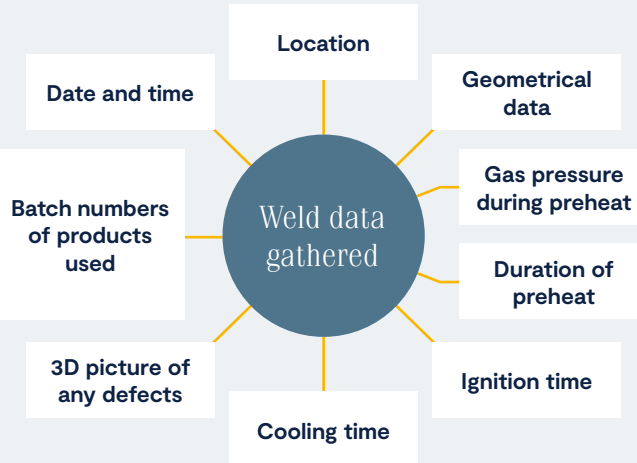
Pandrol has taken the aluminothermic welding process and enhanced it with automation and data to create the i+weld.



## WHAT IS AUTOMATED?

↓ Rail alignment	i+align
↓ Mould sealing	i+seal
↓ Weld preheating	i+heat
↓ Portion ignition	i+ignite
↓ Weld cooling	i+cool
↓ Defect detection	i+detect
• Data recording	i+connect

## WHAT DATA IS GATHERED?



## THE BENEFITS



YESTERDAY. TODAY. TOMORROW.

# i+weld: innovation and impact

Always at the forefront of rail welding, Pandrol established a mechatronics department back in 2018 to focus on enhancing aluminothermic welding (ATW) through automation and data.

Rail networks have used ATW for over a century. Typically, welding is carried out by a two-person crew, with a weld generally taking around 40 minutes to complete and an average crew achieving four to six welds per shift. The process is cost-effective and adaptable

for different environmental conditions, such as worn rails or narrow areas. However, the skilled welders who are needed to achieve a quality result are in short supply and the rail industry faces a labour shortage.

By simplifying and automating aspects of the aluminothermic welding process, the i+weld offers a revolutionary new solution to the challenges faced by railway networks and contractors.

### KEY INNOVATIONS

With i+weld, parts of the ATW process that were traditionally carried out manually are automated and more, higher-quality data is gathered.

	TRADITIONAL PROCESS	I+WELD TOOL	AUTOMATED PROCESS	DATA
Rail alignment	Adjust rails manually with wedges	i+align	Set automatic aligners and press a button to start the sequence	Geometrical data, date and time
Sealing moulds	Apply refractory paste or sand	i+seal	Moulds are sealed automatically during preheating	
Preheating	Adjust pressures, then monitor the flame and duration	i+heat	Set the preheater above the weld and press a button to start the sequence – little or no monitoring	Gas pressure, duration, location, date and time
Portion ignition	Light an ignitor with the preheater	i+ignite	Position the handgun and press the trigger	Ignition time
Weld cooling	Air cooling – takes 30 minutes to 2 hours	i+cool	Launch the water-cooling units – the sequence is automated	Cooling time
Detecting defects	A trained tester spends 10 minutes scanning a weld	i+detect	Scan the head of the rail with an ultrasonic stick	3D picture of the defect
Data recording	Office staff digitise and archive data written on labels	i+connect	Data recording via mobile devices, with some automatic recording	All data for the weld (e.g. location, batch numbers)

### KEY IMPROVEMENTS

**Quality**

Traditional ATW relies heavily on a welder’s skills, with errors in the welding operation – in particular weld preheating and rail misalignment – leading to lower weld performance, increased defect rates and weld rejection.

With i+weld, these issues are addressed through automated preheating and rail alignment. Trials with i+heat showed a 100% acceptance rate. The introduction of i+align will further reduce alignment errors and enhance accuracy, especially for high-speed lines. In addition, better-quality data enhances process reliability by documenting anomalies and triggering alarms.

**Safety**

Automating manual processes reduces the physical strain on welders; for example, the time a welder spends kneeling on ballast to cast a weld is reduced from around 25 minutes to 5 minutes with i+align and i+seal. Automated rail alignment also significantly reduces the risk of hand injuries compared to adjusting rails manually with wedges.



### Productivity

Traditional ATW takes around one hour to complete from start to finishing grinding.

i+weld reduces this to approximately 45 minutes and saves around 20 minutes of active labour time.

As a result, across a five-weld shift, the time saved could be used to cast two extra welds – a 40% increase in output. On quick repair jobs, using water cooling instead of air cooling can reduce the weld temperature to about 50°C within 20 minutes of casting, allowing for immediate finish grinding.

### Welder availability

The simplicity of the i+weld operation reduces the time needed for training. Under the supervision of a qualified welder, track workers can be trained in just three days to set up i+seal, use i+align and carry out preheating using i+heat. Resident welders also need less training – down from three weeks to two.

Easier training, fewer safety hazards and reduced physical strain make it easier to find, train and retain welders compared to when using the standard process.

### Cost

The cost of welding can vary widely depending on a range of factors, including local labour costs and the type of work site. However, thanks to increased productivity and reduced defect rates, i+weld is significantly more cost-effective than the traditional ATW process.

### LOOKING TO THE FUTURE

Currently, rail operators need to strike a delicate balance between flash butt welding, with its substantial fixed costs, and traditional aluminothermic welding, with its staffing challenges.

The semi-automation of ATW in the shape of i+weld is a game-changer. Combining low capital expenditure with high productivity and ease of use, i+weld offers a new scalable technology at a controlled cost that is set to transform the efficiency and sustainability of rail welding operations.



CASE STUDY

# STAYING AHEAD OF THE CURVE WITH TAILOR-MADE SOLUTIONS



## BARCELONA METRO

**CUSTOMER:** BARCELONA METRO  
**DATE:** Due for completion in 2027  
**SECTOR:** Metro

CUSTOMER CHALLENGE

The Barcelona Metro is an extensive network of 12 lines and 140km of track, mostly running underground in central Barcelona and out into the city's suburbs. In 2022, the government gave the green light to resume work on a project to create the Line 9 metro tunnel. The connected Line 9 will be the longest metro line in Europe, spanning 48km in total and linking the north and south lines.

The technical engineering of this unique double-storey 12-metre diameter tunnel presented a real challenge in terms of finding a rail fastening solution that could account for the noise & vibration requirements needed. As Barcelona is a busy city with extensive areas of current and planned residency, it was essential that the mitigation of noise & vibration was considered.

Rail fastenings for the tunnel and line extension required a tailor-made solution. The fastening system not only needed to suit the unique tunnel design, but also needed to be installed within a restricted space, and had to be suitable for the many curves, turnouts and crossovers of the network.

Building on a 20-year working relationship, Barcelona Metro appointed Pandrol to provide an appropriate fastening solution, focusing on resilience, performance and crucially the minimisation of noise & vibration in the bustling metropolitan region.

PANDROL SOLUTION

Taking into account the many challenges, Pandrol's Bonded Baseplates were deemed to be perfectly placed for the project – a high-resilience solution with extraordinary capacity to guard against vibrations generated from the track being transferred to the surrounding structures.

Bonded Baseplates offer an effective anti-vibration system through the use of a resilient bonded polymer, reflecting the vibration energy rather than absorbing it, whilst also being extremely easy to install. Lightweight – weighing only 17kg for the whole system – Bonded Baseplates are easy to transport, which meant the team could carry out step-by-step installation inside the tunnel.

The system comprises two cast iron plates, bonded together with a natural rubber compound to provide a specific stiffness performance. The 40cm thick slab dividing the tunnel cross-section was heavily interlaced with reinforcements, so it was important to choose a system which had only two anchorages to avoid damaging these during installation. The Pandrol solution was designed to avoid the potential risk of the thin slab of the upper deck creating an amplification effect of vibrations being transferred to it.

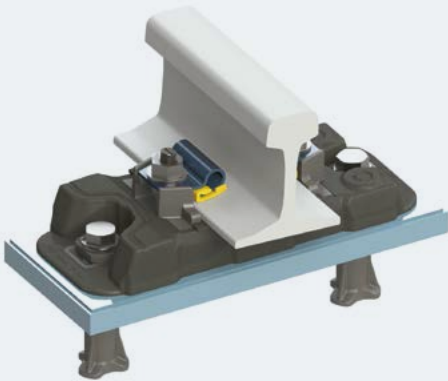
Because of the many complexities of the project, Pandrol's design team engineered an entirely new element for the Bonded Baseplates – lateral reinforcing plates which can move in different axes to account for the curves, switches and crossings.

The system's low stiffness deals with the dynamic load by reducing the vibrations transmitted to the ground and distributing them along the supports. As a result, vibrations are isolated from the ground and noise generated by the moving wheels on the rail is attenuated.

Not only that, but the Bonded Baseplates also have a very high electrical insulation performance with the rubber being vulcanised to the cast iron plates. The rubber coating also offers protection from corrosion, increasing the longevity of the solution.

BONDED BASEPLATES:

- Highly resilient and flexible fastening solution with extraordinary capacity to absorb vibrations
- Provides both vertical and lateral stiffness via two independent cast baseplates
- High levels of electrical resistance
- Lightweight and easy to transport and install, featuring just two anchorages



THE RESULTS

Through the adoption of Bonded Baseplates on Barcelona Metro's new tunnel and line extension, Pandrol has provided a resilient maintenance solution, tailor-made for the complicated, curved network, and designed to minimise noise & vibration in this heavily populated area.

A technical study demonstrated that Bonded Baseplates achieved vibration attenuation between 20 and 35 dB on existing Barcelona Metro lines.

Line 9 is planned for completion in 2027 when it is predicted that the project will lead to 8,130 fewer vehicles on the roads each day.



ASK THE EXPERT:

# Common Interface System



**JOHN PORRILL**  
TECHNICAL DIRECTOR AND HEAD OF  
THE FASTENING SYSTEMS PRODUCT LINE

**Q: Why did Pandrol create the Common Interface System?**

In the past, non-ballasted track (NBT) was aligned to specific fastening systems and anchorages. This meant that if performance requirements needed to change, for example if residents complained about noise & vibration in an urban area, it was difficult to adjust the track performance. By providing NBT with a common connection point for a range of different fastenings, the Common Interface System enables new mitigation requirements to be met simply by changing the fastening system, rather than having to modify or replace the whole track.

**Q: What does the Common Interface System consist of?**

The Common Interface System consists of two engineered plastic construction plates with retaining features, as shown below. Reinforced plastic dowels sit underneath the plates, enabling anchor screws to be installed. The fastening system can be delivered to site fully pre-assembled on pre-cast concrete elements, as shown with the FCA system here.



**Q: Which fastenings is the system compatible with?**

The Common Interface System is compatible with the Pandrol FCA, DFC and Vanguard assemblies. We are currently working to develop SD threaded fastening assemblies to work with the system.

**Q: How is the system configured for different noise & vibration mitigation requirements?**

Where the need for noise & vibration mitigation is low, the Common Interface System is fitted with a simple, medium resilience fastening like Fastclip FCA, with a single resilient rail pad. For intermediate mitigation levels, the FCA fastening is replaced by a more resilient set of components such as DFC, with the addition of a baseplate and a highly resilient baseplate pad. For extreme noise & vibration mitigation requirements, for example when a metro tunnel passes under a hospital, Pandrol Vanguard fastenings can be used. Rather than sitting on a pad or the baseplate, the rail is held by resilient blocks, producing an air gap under the rail foot and offering exceptional lateral stability.

**Q: What is the assembly stiffness of the different fastenings?**

The specific stiffness depends on the CEN track category, however as a guide:

- FCA – static stiffness >40kN/mm
- DFC – static stiffness 16–25kN/mm
- Vanguard – static stiffness 5kN/mm

**Q: What are the key benefits?**

The cost benefits are clear – being able to simply replace the fastening system, rather than the whole track, can save millions in unnecessary costs. The process is much simpler and quicker, creating less disruption for the transport system and local communities. And with concrete's high carbon footprint, increasing NBT's lifespan has immense sustainability benefits. Once removed, fastening systems can be recycled or, in some cases, reused on another project.

“The Common Interface System enables new mitigation requirements to be met simply by changing the fastening system”



PRODUCT SPOTLIGHT

## Pandrol's SD Fastening System: Raising the Bar in Rail Innovation

Pandrol's SD is a pre-assembled threaded fastening solution for use in most track applications using threaded fasteners. The system provides an efficient, controlled clip guidance from the parked to the in-service position.

The SD Clip System is tensioned using a screw and insert system. This provides enough axial force to compress the clip and deliver the necessary clamping force to the rail foot. SD Clips can be used across all sectors of the railway infrastructure, from heavy haul railways through to the light rail sector, and everything in between. Its many technical advantages mean the SD System is currently being implemented across a range of applications to update tracks from ageing screwed systems that have been in use for many years.

**ECO-DESIGN**  
Lightweight system and compact design:

- Reduced environmental impact
- Reduced manufacturing and logistical costs – saves 1,500kg of raw material per 1km of track when compared with other screwed systems
- Ability to be used in small spaces such as turnouts



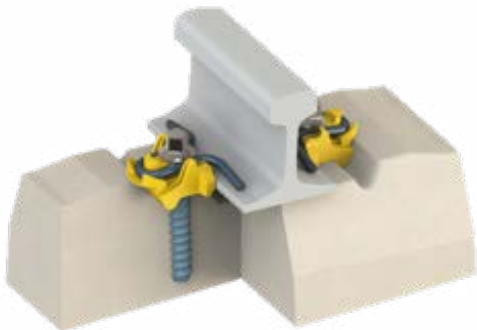
**INCREASED ROBUSTNESS & LIFECYCLE**  
A significant increase in the natural frequency is key to increase the robustness of the tension clamp:

- Higher natural frequency of the clip reduces sensitivity of the tension clamp to vibrations caused by passing trains
- Enhanced clip design to avoid frequencies where destructive amplitudes are generated, reducing risk of clip failing in fatigue



**SAFE DRIVEN & SOSO FEATURE**  
Preassembled nature with Switch On/Switch Off (SoSo) function:

- Very high rates of track construction and maintenance
- Huge savings in labour due to reduction of handling costs throughout the whole lifecycle of the system







**PANDROL**

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