

PANDROL

Making connections that
drive rail forward

TRACK REPORT 2022



The Pandrol Promise

SAFETY, AVAILABILITY,
SUSTAINABLE LIFETIME VALUE

INSIDE

Sustainability at Pandrol

OUR JOURNEY TO
A GREENER FUTURE

Noise and vibration

INNOVATION
FOR MITIGATION

High speed developments

TRANSFORMING
TRAVEL AT PACE



Expert insights,
project stories,
product profiles
and more...

LETTER FROM the Editor

Welcome to the 2022 Track Report from Pandrol.

Pandrol is a business founded on a passion for innovation, and our unique heritage is still at the heart of how we do business today. Our strength in product development and engineering know-how have enabled us to maximise our presence across rail fastening systems, electrification, track equipment, aluminothermic welding and sustainable resilient systems. Today, just as a century ago, we pride ourselves on meeting our customers' requests with enthusiasm, passion and consistently outstanding solutions.

Over the years, our innovations have transformed rail infrastructure in over 100 countries. We've designed, developed and manufactured equipment that has changed the way railways are constructed and maintained. In the process, we've encountered just

about every problem, question and solution before, and have amassed a wealth of experience and expertise.

Above all, we believe in quality and are committed to value and excellence in the products we make and the services we provide. As One Pandrol, we share our global knowledge freely to help our customers solve their problems and stay on track. Throughout the unprecedented challenges of the Covid pandemic and climate change, our teams have innovated and adapted to deliver support to our customers.

This Track Report celebrates what makes Pandrol unique, sharing the latest insights, innovations and solutions that are shaping our industry around the world. Thanks to everyone who has contributed. We have much to be proud of.



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The Pandrol Promise

“We maximise rail infrastructure safety, availability and sustainable lifetime value.”



As good as our word



Guy Talbourdet, Chief Executive, explores how we put our Pandrol Promise into practice.

We first established our promise to customers back in 2017 and have recently updated it to include our sustainability statement. So why is the Pandrol Promise so central to who we are and everything we do as an organisation? And what is the significance of each of its elements?

AN END-TO-END SERVICE

We support our customers at every stage of the process. This spans from design and installation, to operation, monitoring and maintenance, continuing right through to the end of life of our products.

Our track expertise extends from fastenings and rail insulation to welding and electrification, and our One Pandrol team spans every corner of the world. We harness their expertise – backed up with 100 years of experience – to use the optimum technology to address our customers' technical issues on a global scale.

The three original aspects of the Pandrol Promise – safety, availability and value – are inextricably linked in our approach to solving our customers' challenges.

Maximising track availability will always be a priority – rail infrastructure owners are, in effect, asset managers. To help them in this regard, we find solutions that reduce maintenance requirements, limit the need to go on track, and extend the life of the rail infrastructure... All of which also increase safety and add value.

Our Fastclip family of fastenings, for example, has been specifically designed to enable fast and efficient track installation and reduce maintenance costs thanks to its unique 'switch-on, switch-off' feature. As a result, the track is out of action for far less time when installing fastenings, labour is dramatically reduced, safety is increased, and there are cost savings across the life of the railway.

THE SUSTAINABILITY DIMENSION

In response to the growing imperative to be more sustainable in our sector, we have now added sustainability to our Pandrol Promise as we focus on 'sustainable lifetime value'. We see sustainability as central to our work to meet global transportation needs for generations to come. The railway is already the most environmentally-friendly mode of motorised transport – we want to make it even more so.

We are committed to designing, installing and using products that, over their lifetime, need less maintenance and reduce carbon emissions. We are highly focused on using recycled materials, as well as recovering, repurposing, reusing and recycling at the end of our products' lives.

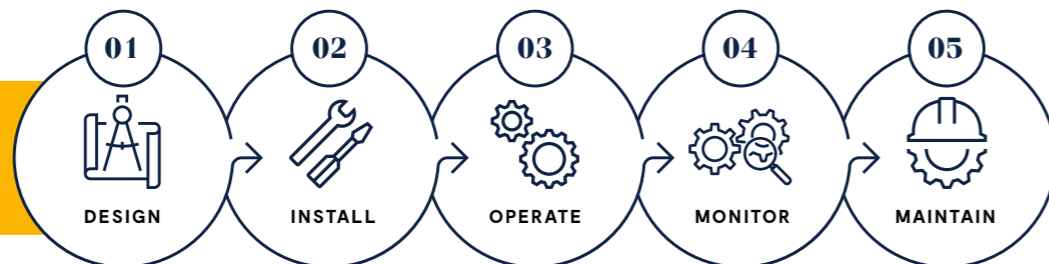
Our Under Sleeper Pad (USP) is a great example of a product that fulfils every aspect of the Pandrol Promise. The USP is an elastic product made of high-quality resin-bonded rubber that can be attached to the base of a sleeper quickly and easily. Designed for durability, it is highly resistant to changing atmospheric conditions, chemical exposure and mechanical fatigue. Its parameters can be adjusted to achieve specific vibration attenuation targets. It reduces rail corrugation in tight curves and decreases the stress within each sleeper thanks to a more even distribution of axle load, whilst also adding life to the ballast.

The result? Easy to install, maintenance-free and long-lasting, the USP maximises track availability, safety and sustainable lifetime value. Moreover, it is made from over 90% recycled materials and is 100% recyclable, as certified by an environmental product declaration (EPD).

As we move towards our goal of creating a circular economy, we want solutions like the USP, which fulfil every aspect of our Pandrol Promise, to become the norm. We see this as key to meeting not only our customers' requirements, but also the needs of future generations.



END-TO-END SERVICE



SAFETY

AVAILABILITY

SUSTAINABLE LIFETIME VALUE

THE
PANDROL
PROMISE



Pre-assembly and our promise

John Porrill, Technical Director and Head of the Fastening Systems Product Line, explores how pre-assembled fastenings align with the Pandrol Promise.

The practice of pre-assembly is becoming increasingly common across a range of sectors, and its benefits are widely recognised – from eco-friendliness, safety and quality, to savings in cost and time. As this suggests, pre-assembly is a natural fit with our Pandrol Promise and we are looking to maximise it increasingly in our new and existing products as a great way of adding value to the client.



PRE-ASSEMBLY IN PRACTICE

The Fastclip Baseplate (FCB) is a good example of how Pandrol is putting this into practice. The FCB is a fastening system for non-ballasted track applications that enables a range of both vertical and lateral adjustments to be made quickly and easily, with minimal additional components. It can be used with all typical track construction methods and configured for various track stiffness and rail clamping force requirements.

The FCB already combines safety, durability and the latest technology, and provides excellent track references. Offering the option for pre-assembly brings another dimension to its benefits.

When pre-assembled, the FCB is supplied as a captive unit with the clips in the parked position. On pre-cast concrete elements, the unit can be positioned and tightened down into precise alignment. When used with top-down wet pour track construction methods, the unit is hung from the rails prior to concrete being poured to the required level.

WHAT ARE THE BENEFITS?

Contractors and the railway benefit in a number of ways from opting for pre-assembled baseplates.

- The product comes complete and correctly assembled – the risk inherent in putting parts together from a loose bag of components is eliminated.
- Installation is quicker and safer – the fiddle factor is taken out!
- Pre-assembled units lend themselves well to mechanisation, robotics and automation. For example, robots can apply pre-assembled FCBs to sleepers or slab track 24/7, with a much higher level of consistent accuracy and reproducibility than is possible with manual application.
- As this suggests, accuracy is enhanced by the use of pre-assembled fastenings, particularly when combined with automation. This is particularly important in applications like high speed, where the degree of accuracy needed in placement is considerably more sensitive than in heavy haul or even a standard mixed freight track.
- If a slab unit is damaged in track, it can be replaced quickly and safely by an identical unit. The new FCB modules can be fitted quickly and with the same pattern of accuracy as the original, using data stored on an RFID tag located on the original slab unit.
- Importantly from an environmental perspective, it is still possible to replace individual components within the pre-assembled unit. For example, pads and insulators might need to be replaced during the lifetime of a rail. Pre-assembly of sub-components can support this – a replacement clip comes with a toe insulator already fitted, for example, saving time spent on maintenance processes.

Considering these factors, our use of pre-assembly will surely grow as we focus on keeping our Pandrol Promise to customers in all we do.



THE PANDROL PROMISE
SAFETY

ASK THE EXPERT:

Keeping people off track



MARIA NILSSON
HEAD OF EQUIPMENT AND CONTROL PRODUCT LINE

Q: Why is it important to keep people off track?

The most important reason to reduce the number of people on track is, of course, safety. Despite advances in safety and technology, the railway is still one of the most dangerous working environments in the world, with moving trains, equipment and the risk of electrocution. The most effective way to ensure the safety of rail workers is simply to reduce the number of people on track. This will also have a beneficial effect on recruitment – the railway industry has an ageing workforce and is finding it challenging to recruit young people to work in such a dangerous environment.

Q: Are there advantages to keeping people off track beyond safety?

When operators only have a window of time set aside for maintenance or are working to a strict installation schedule, time is also a huge factor. We promise to maximise availability for our customers, and this is what drives us to create smarter, more efficient tools that require fewer people to operate them and result in less time wasted. Introducing automation brings advantages in terms of quality and consistency. We also reduce costs both during maintenance and in the long term as we eliminate the chance of a low-quality offering.

Q: What are the main ways in which Pandrol reduces the number of people needed on track?

The railway industry can be so steeped in heritage and tradition that it takes an innovative company like Pandrol to come in and drive change. We are exploring mechanisation and automating processes on track relating to both maintenance and installation. We have already seen our services and products help to decrease the number of people working on track and these results drive us forward, inspiring us to continually develop smarter tools.

Q: Why is Pandrol well-placed to drive this strategy forward?

What we have seen in other industries has taught us that when it comes to automation, inspection is always the most straightforward part. It is once you get to the manipulation and execution stage of automating repairs or manufacturing that it really becomes challenging. And this is where Pandrol comes in. Our expertise in automation and deep understanding of rail infrastructure makes us the best company for the job.

Q: What do you think the future of railway maintenance looks like?

Industrial automation is a trend that will continue to grow. Maybe one day in the not-so-distant future we will all live in a world featuring a completely automated railway: maintenance will be predicted using sensors and digital twins, and repairs will be completed using a robotic workforce without the need for human intervention. But until then, I predict advancements in the capabilities of the machines we produce and a growing confidence in the tasks carried out via automated maintenance and installation.

“

The most effective way to ensure the safety of rail workers is simply to reduce the number of people on track.

”

THE PANDROL PROMISE
SUSTAINABLE LIFETIME VALUE

UNDER SLEEPER PADS IN HEAVY HAUL

Under Sleeper Pads are on the up in heavy haul, playing an important role in extending the life of the railway.



Recent years have seen a rapid growth in the use of Pandrol's Under Sleeper Pads (USPs) in heavy haul railways. So why are USPs so useful when loads are high?

The main purpose of USPs in heavy haul is track protection. Introducing an elastic element to the base of sleepers improves load distribution over the track and its components, both longitudinally and transversely.

Without USPs, ballast is the first elastic track element to consider. Fasteners and ground are also resilient, whereas the wheel, track, and sleepers are all rigid. When heavy loads pass over the track, the ballast is compressed and, with a ballast sleeper contact area of between five to eight per cent of the total surface, the compacted ballast gets stiffer.

Under Sleeper Pads introduce an additional elastic element between the ballast and the sleeper. As a result, the contact surface increases to over 30%, improving load distribution, consistency of track stiffness and overall track quality. Different USP specifications are available to provide the ideal elasticity for specific rail infrastructures. Elastic levels need to be controlled to ensure that while the stiffness of the system is decreased, the elasticity doesn't cause too much track deflection.

LIFELONG BENEFITS

What are the long-term benefits of this?

- Less rail corrugation (especially on curves)
- Reduced frequency of levelling, lining and tamping (by a minimum factor of two)
- Lower maintenance costs
- Extended life of the track superstructure

With such compelling reasons for their use in heavy haul, the future looks bright for Pandrol's USP solutions.

THE PANDROL PROMISE
SAFETY



Pandrol's holistic approach to safety is reflected in our ergonomic equipment design.

When we talk about safety on railways, it's natural to think of the extreme dangers that people sometimes face when working on track with moving vehicles. However, while these hazards are always at the forefront of our minds, at Pandrol we also focus on the long-term safety of track teams by seeking to improve day-to-day working environments through effective use of ergonomics.

UNPACKING ERGONOMICS

Ergonomics is the scientific study of people and their working conditions. Our Pandrol ergonomic specialists use their knowledge and understanding to ensure equipment and tools are designed to increase productivity and efficiency while reducing discomfort and fatigue. The result? A safer workplace and reduced costs.

In the office, this is likely to mean adjustable workstations and computers, ergonomic chairs and a footrest under the desk. On track, it might be lighter equipment that reduces time spent kneeling, automated processes, or battery-operated products that reduce noise and fumes.

ERGONOMICS IN PRACTICE

Often, speed and efficiency go hand in hand with designing products and processes that reduce fatigue and improve the working environment. A good example of this in practice is the Vortok Stressing Roller (VSR), which is used when rail stressing and changing sleeper pads. The VSR is attached to the rail fastening and lifts the unclipped rail from the sleeper by means of a rotating lift arm and bearing. To reduce friction, ball races are used instead of plain rollers, and are in contact with the underside of the rail head rather than the foot or web of the rail. Once lifted, the rail can be moved with very low friction and the resultant stress distribution is optimised.

By enabling rails to be lifted and moved with ease in this way, the VSR offers:

- higher productivity
- a significant reduction in labour and operator effort
- time savings of more than two hours on a standard 900m stressing operation.

TECHNOLOGY-ENHANCED ERGONOMICS

Technology is often used to further enhance ergonomic solutions. In the case of the Vortok Stressing Roller, the precision of the rail stressing process is improved by the use of VERSE – a lightweight, accurate, low-cost monitoring system that checks a rail is at the correct stress-free temperature. This allows operators to predict where track is vulnerable to stress-free temperature change and plan cost-effective re-stressing programmes, reducing the risk of buckling and fracturing and achieving new track quality acceptance.

With VERSE, the rail's stress-free temperature is determined immediately, trackside, using a handheld computer. Readings are exported, with files downloadable to databases like Excel and Access for integration with other track data. Where necessary, on-the-spot maintenance and safety decisions can be made without knowledge of any residual stress history of the rail. With each measurement taking just 20 to 30 minutes (depending on the rail fastening), less time is needed, fewer people are on track, and more accurate results are achieved.

A win-win, stress-free solution from every perspective!





Signalling equipment made easy



Modern signalling systems and balises require a modern solution. Craig Mulvay, Technical and Commercial Development Manager, explains why.

Balises are a crucial part of the modern railway system. Acting as a kind of central nervous system for the rail network, balises work as beacons or transponders, communicating to give an accurate location of the train for modern signalling systems, such as European Train Control Systems (ETCS) and Communication Based Train Control (CBTC). If fitted incorrectly, operators run the risk of losing the safety-critical data which balises transmit. For a reliable rail network, rapid and efficient installation is key.

Pandrol's unique position as track experts with additional knowledge of the signalling interface makes us market leaders – not only in providing balise-fitting equipment, but also in creating bespoke solutions for customers' unique needs. Our design capability saves customers time and significantly reduces the total cost of deploying modern signalling equipment into the track environment.

COST-SAVING INNOVATIONS

Traditional methods of balise-fitting installations are laborious, with ballast needing to be removed from around sleepers or alternatively, sleepers needing to be drilled and anchored directly. These practices can be risky, opening up the possibility of degrading track support or damage to sleepers, which could prove costly later down the line.

The Pandrol (Vortok) Balise Mount Systems (BMS) have revolutionised balise installation. The BMS On Sleeper Beam and BMS Clamp Beam increase efficiency and ultimately reduce costs for customers.

With no power tools needed, installation can be facilitated using simple hand tools. This means that our solutions can be fitted in a single track visit, as opposed to traditional methods where sleepers must be identified, drilled and anchors installed, with additional drying time allowed over the course of multiple site visits. This reduced time for installation and track possession equates to savings in the cost of installation too, by decreasing labour requirements and improving project management flexibility for operators. In addition, Pandrol products have the ability to be part-installed with all the mechanical parts fitted prior to the electronics, if needed.

With our On Sleeper Beam, we estimate on-track time of less than two minutes per beam installation. The beams are as easy to remove as they are to install, without the need for specialist tools or adjustment. This means that infrastructure owners also reap the reward of the quick-fit Pandrol system as the system can be removed and replaced quickly before and after major maintenance works to the track. After installation, should commissioning checks require adjustments to be made, these will be easy to do with the equipment repositioned in a fraction of the usual time.

PERFECTLY POSITIONED FOR ACCURACY

The positioning of balises is vital for reliable data transfer to on-board rolling stock receivers. If the transponder isn't placed within tolerance, there is a risk the train will fail to read it when passing over the track. That makes reliable balise positioning vital for safe and reliable signalling systems.

Using traditional methods of fitting, users would need to manually position the balise, working out the correct spacers between the balise and the top of the sleeper so that it ends up at the correct height in relation to the head of the rail. This can lead to issues with balises being installed incorrectly. If the positioning ends up being too high, too low or off-centre, this will impact the reliability of the railway or cause delays with the project overall.

But with our balise-fitting equipment, the product arrives to site pre-positioned by the Pandrol design team, so that no additional positioning is required on site. This removes the risk of human error and significantly reduces the risk of read errors between balise and receiver. Our simple solution has created a more efficient and simple process.





OUR PRODUCTS IN FOCUS

The Pandrol (Vortok) BMS have been used to install a wide range of signalling equipment, including balises, transponders, beacons, norming points and RFID tags. Since 2001, Pandrol has sold over 250,000 Clamp and On Sleeper Beams.

The On Sleeper Beams use the existing rail fastening as an attachment point and are capable of interfacing with all major fastening systems, such as Pandrol's own e-Clip, Fastclip and NABLA, as well as Schwihag, Vossloh, K-type Plates, Delkor and direct to timber sleepers.

On Fastclip and e-Clip systems, simple hand tools can be utilised to extract the clip and put it back in. Using the heel load (the reactionary load) of the clips to hold down the beam, the clips can be removed using the hand tool, the beam placed in position and the clips reinstalled.

Balises can either be positioned over the sleeper to allow open access to the space in case the consolidation of the ballast is required, or they can be placed between the sleepers. For the latter option, Clamp Beams can be secured to track via mechanical clamping to the underside of the running rail foot. These are available in single or double clamp beam formations.

BESPOKE DESIGN SOLUTIONS

Our equipment can be adapted to solve virtually any on-track signalling equipment challenge. So when customers have unique requirements that go above and beyond the standard signalling equipment, we have the ability to develop great solutions to solve their problems.

As part of our product offering, we can create bespoke designs, managing the entire process for customers. We can reduce the total cost of install by using smart solutions which facilitate the deployment of equipment into track environment in the most efficient way possible.



Pandrol's track engineering expertise helps signalling customers to analyse and understand the optimum method of installing signalling equipment into their unique track environments. Where most providers are either experts in track or signalling interface, at Pandrol, we have the knowledge and understanding of both.

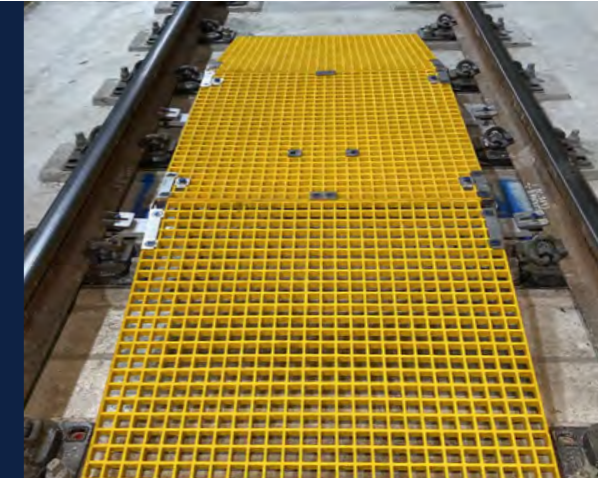


SYDNEY METRO: A SPECIALIST SOLUTION

One example of our bespoke products created through collaboration with customers for project-specific applications is the Anti-Trip BMS specially developed for Sydney Metro.

Sydney Metro required access through its metro tunnel so that maintenance staff and passengers can walk safely down the centre of the track, for example in an emergency scenario.

To meet these needs, Pandrol designed a product which could assume two roles. The Anti-Trip BMS is a specialist product which installs a balise into the track whilst also forming a walkway route through a tunnel. Our bespoke system utilised the Clamp Beam system to avoid the requirement of drilling into the track, and also met the multiple requirements of the customer.



BALISE PROTECTION FOR COLD CLIMATES

In colder climates, the track can suffer from a phenomenon known as 'ice bombs' or 'ice shedding'. When a train accumulates ice on its body, changing pressures when exiting tunnels can cause huge chunks of ice to fall off the train. These large lumps of ice can smash into signalling or other equipment when they land in the track environment, causing severe damage.

In response, we developed equipment to protect the balise even if ice hits it, taking the impact and protecting the balise. Though the technology was quite the engineering challenge, the design we created has been tested to withstand the customer requirement of a 10kg particle travelling at 250km/hr.

A WORLD OF KNOWLEDGE

Pandrol has a long history in the development of mounting systems, with our extensive experience informing our current offering. Prior to BMS, Pandrol supplied Train Protection & Warning System (TPWS) mounting frames, which used similar materials and construction methodology. The first TPWS units were deployed in 1990, and since then more than a quarter of a million balise mount systems have been sold worldwide.

Our pioneering work for TPWS includes the innovation of track fasteners as a fixing point and pultruded fibreglass as a structural material to support the signalling asset. Following this, we launched our first official BMS, the H-Frame, followed by the heavy-duty Automatic Warning System (AWS) Rapid Fit Frame, capable of carrying up to three AWS magnets of over 70kg each.

Today, Pandrol's established design fundamentals underpin the work we do, with Pandrol BMS supplied to over 20 countries worldwide. Our products certainly stand the test of time, with high-quality innovative solutions that make us the largest player and true market leaders in the signalling equipment space.





ASK THE EXPERT:

SD Clip System



JOHN PORRILL
TECHNICAL DIRECTOR AND HEAD
OF FASTENING SYSTEMS PRODUCT LINE

Q: What is an SD Clip?

The SD Clip – ‘SD’ stands for ‘Safe Driven’ – is a modern screwed fastening system produced by Pandrol Fastening Systems Product Line. Designed to be delivered pre-assembled on the sleeper or slab element, the SD Fastening System provides controlled clip guidance from the parked to the in-service position, eliminating the need for track workers to place their fingers in areas of potential safety risk. The SD System can also deliver high rates of installation with mechanical methods.

Q: How do SD Clips work?

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.



Q: Where are SD Clips best used?

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. With a family of SD Clips designed for specific market segments, each fastener type provides a different set of performance characteristics to meet the needs of a particular application (in combination with the other fastening assembly components). The SD Clip System can be retrofitted to existing SKL sleeper and slab profiles, making it the perfect upgrade product during a rail change, further extending the useful life of the sleeper or slab.

Q: The SD System is a screwed fastening solution. How is this different to the self-tensioning alternative?

With self-tensioned fasteners, the clamping force holding the rail to the sleeper is generated by deflecting a spring clip through a given distance during the clip installation process – hence the term ‘self-tensioned’.

Screwed fastening systems generate this same force by deflecting the clip legs during the process of installing the screw anchor. As the screw is installed it compresses the clip legs, which are made from spring steel. In doing so, the clamping force required is generated.



THE PANDROL PROMISE
AVAILABILITY

REDUCING REPAIR TIME AND DOWNTIME

Pandrol’s Technical Director of Welding, Frédéric Delcroix, explains how head wash repairs maximise availability.



Rail defects are a nuisance for passengers, operators and welders alike. At best, they can impact on the quality of the passenger experience, with bumps and noises along the journey. At worst, they can cause wheel flats, which are costly and potentially dangerous. As with any railway repairs, fixing rail defects requires a period of downtime. Replacing a rail section through plug repair can take up to four hours, causing a considerable amount of disruption for the network. Pandrol’s head wash repair (HWR) process provides a cost-effective and efficient alternative.

THE HWR ADVANTAGE

With the increase in rail hardness, wear has become one of the most common causes of rail replacement. This affects all railway networks, with the continual impact of wheels jumping on the rail causing defects to become an issue if they aren’t treated in the early stages, before they reach a critical size. Faced with this problem, network operators have a choice: to repair the defect through rail replacement or through HWR.

Undertaking a traditional repair through rail replacement takes a lot of resources. The length of rail that needs replacing could be between four to six metres for high speed. A locomotive must be used to transport the new piece of rail, along with a team to carry it. The process itself involves making two welds. In addition, the rail must be restressed, which is time consuming and requires additional rail stressor equipment.

Rather than replacing the entire section of rail, HWR involves simply treating the defect and filling the gap with a new weld, just like repairing a crack on a car windscreen. This approach saves huge amounts of time and money, with traditional rail replacement costing four times as much as HWR and taking twice the time to complete. Without the need to bring in a new piece of rail, the process becomes much safer, too, with fewer people needed on the track and less heavy lifting.

The aluminothermic weld process is carried out using specially designed moulds. After unmoulding, the weld is trimmed and ground in accordance with the network specifications. The whole process only involves one weld, two welders and one HWR kit. After the weld has been made, the track is cooled, refastened and then the repair is complete. Ninety percent of the rail shape can stay as it was, without the need to cut, realign or restress the track. The whole HWR process takes ninety minutes, as opposed to up to four hours for rail replacement.

A WORLD-LEADING SOLUTION

HWR is versatile and can be used on a range of rail defects of varying sizes. In France, 2,000 welds take place each year to repair flash butt welds, which often suffer from squats or dips. HWR is also used to repair defects on the parent rail, including dips or spots on the rail, and is suitable for transversal defects, shelling and corner gauge.

Maximising uptime is central to our Pandrol Promise to customers and HWR allows us to achieve this. We are proud to be a world leader in HWR, adding value to rail networks in the USA and Canada since 2008, in the UK since 2013, and in France since 2015. Pandrol has also developed HWR systems for many other countries, such as Brazil, Russia and Australia, and has plans to promote this innovative solution to the network the world over.

It is clear that HWR offers an incredible opportunity to maximise availability for operators, making the rail network safer, smarter and better for everyone.





Intelligent clipping for the future

Pandrol is proud to be leading the way with our new, intelligent Clip Drivers – the next generation of clipping machines.

At Pandrol, we have been developing clipping solutions for decades and our innovative automated solutions have improved safety, speed and accuracy on thousands of miles of track across the world. Now we are proud to have launched a new range of intelligent clipping machines that are set to shape the future of clipping.

NEXT-GENERATION-MACHINES

Featuring three new Clip Driver products, the CD200 IQ, the CD300 IQ and the CD400SP IQ, our new range represents a significant upgrade on the first-generation models. Designed with efficiency in mind, each addition to the IQ range features a 'smart system' incorporating an intelligent control system which monitors the machine's operation and actively controls the clipping operation. The control system provides information on clips installed and operating hours, while also preventing any incorrect usage of the machine.

The new intelligent systems offer a wide range of options for clipping at a speed and efficiency that suits any installation and preferred work method. The CD200 IQ can clip up to two clips per cycle at a rate of 20 sleepers per minute, and the CD300 IQ and CD400SP IQ clip up to four clips per cycle at 40 and 30 sleepers per minute respectively. The range of modular products can be utilised for a broad range of tracks and can be used in conjunction with Pandrol's full range of Fastclip and e-Clip products.

As well as increasing efficiency and clipping capabilities, the range delivers wider benefits such as new quality control features, remote control operation, and a new EU Stage 5 diesel engine on the CD400SP IQ that brings fuel efficiencies and carbon footprint reductions. Beyond the robustness and versatility of the machines, plus the logging of operations, this new generation of Clip Driver also offers a built-in diagnostic system to vastly improve the maintenance, repair and testing effectiveness.



A SUSTAINABLE OPTION

In addition, this year Pandrol has been delighted to announce the launch of the CD100 Battery, an emission-free portable clipping machine designed for quick and easy clipping and declipping of the Pandrol Fastclip range.

The CD100 Battery combines safety and efficiency to save time and money. The battery is compact and lightweight – it can be easily transported on site and is suitable for use by a single operator. As part of its ergonomic design, a weight-bearing wheel runs along the rail, dramatically reducing the physical strain on the operator and making it safer to use. Although optimised for smaller clipping and declipping applications, the CD100 Battery has been designed to be extremely versatile. It can be coupled to other equipment and is strong enough to lift a sleeper up to 10mm.

The CD100 Battery replaces the need for manual hand tools for small jobs, eliminating the risk of tools slipping and physical stress injuries. Powered by battery, this emission-free clipping machine is suitable for use in tunnels, stations and in densely populated areas where working safely with low noise and clean air is a priority.

The launch of the CD100 Battery is a fantastic step for us to unify the great work being done to optimise battery power and sustainable materials across Pandrol's track equipment.

Intelligent clipping machines are just one example of the many ways Pandrol helps rail networks to carry out maintenance work in record time, maximising availability and reducing the number of people on track. Our smart machines offer an excellent alternative to conventional clipping methods, automating the process to carry out the work in unparalleled time.





ASK THE EXPERT:

Retrofit



WAYNE PEACOCK
GLOBAL HEAD OF SALES

Q: What does it mean to retrofit?

For many reasons, there are times when a rail fastening system's performance may not meet its current or intended purpose. This may be due to changes in the operating environment, or simply because the system requires a higher standard of performance than was originally intended. The operator then has a choice. Either they can rip out the old system and install something new, or they can look at less disruptive ways of bringing the track form up to the required level of performance and safety. In some cases, it might be more desirable from a cost and track availability perspective to retrofit selected components, thereby providing an upgraded bespoke solution on the existing mountings of the original system. This is what we mean by 'retrofit'.

Q: Why would you choose to retrofit an assembly?

One common example would be installing retrofit rail fastening components to upgrade the acoustic performance of the existing non-ballasted track in transit (Light Rail or Metro System). For transit projects, the design of the original selection and track form is usually based on an environmental impact study where noise and vibration levels are predicted using acoustic models. This modelling is not an exact science, however, and the combination of the vibration source and frequency, along with the path of vibration, can sometimes lead to surprising levels of secondary noise and vibration in nearby buildings.

Therefore, one retrofit solution would be to modify the design of the track fastening. By lowering the track stiffness with a system that will install onto the existing anchorage points in the concrete slab, this will make the track more resilient. The rehabilitation is less disruptive than a completely new installation, has a lower cost, and is less harmful to the environment.

Other retrofitting examples include converting a rail-fastening system to an anti-theft type, or Pandrol's 'Re System', a specially designed retrofit for e-Clip fastenings to extend the life of a railroad tie or sleeper.

Q: How do you know when retrofitting is the solution to your problem?

Pandrol has the capability to address the fundamental design of a rail fastening system to meet the intended or new performance requirements. Where we come across an existing railway which is looking to solve a particular problem or to enhance performance, we look at the most cost-effective way of providing a solution. As an innovator, we have the option of pursuing a bespoke design to meet the customer's objectives. We can do this safely and reliably due to our experience of numerous projects and our investment in innovation and R&D. Finding a solution for existing railways with specific performance needs is a big part of our offering and it's one of the things that differentiates us from our competitors. Determining whether a retrofit solution is the right way to go comes from intimacy with the end customer; by talking through the requirements and options we can help navigate to the best solution.

Q: Is the process for retrofitting an assembly the same as for installation?

Retrofitting is a different process as many features of the system design remain fixed by the existing infrastructure and track form. For example, there may be a tunnel which restricts the headroom for the rolling stock and therefore limits the height of the fastenings system, or an existing track slab with existing anchor positions or bolts, or there may be an existing railroad tie or sleeper which must be used, the design of which drives the geometry of the fastening components.

Q: What does the future for retrofitting look like?

Retrofitting enables future-proofing, so that railways can be built knowing there are solutions in products and services that can enable retrofit designs to keep pace with new demands. Pandrol is looking ahead by designing interchangeable fastening systems that have a common anchor footprint. Each interchangeable system has a different performance level so that the performance of the track form can be changed without significant track intervention and without serious disruption, thus maximising the availability of the railway for operating trains whilst the tracks are being upgraded. Retrofitting also minimises the carbon footprint as it recycles the parts of the track form which remain undisturbed.

The future depends on how rail operators address the whole life value of their track infrastructure and how they make decisions today that give them flexibility to meet the demands of tomorrow.

Sustainability:

Pandrol's journey to a greener future

We have chosen to add sustainability to our Pandrol Promise because acting in a sustainable way is now front and centre in all we do.



With our quality products inherently increasing the lifespan of our railway lines, sustainability has always been an area that Pandrol has taken pride in. But now we need to focus on increasing the sustainability of the railway still further. This involves going beyond the mode of transport itself, and thinking more widely around the sustainability of rail infrastructure and the entire supply chain.

ASK THE EXPERT:

Sustainability and the railway



OLIVIER JULLIEN
CHIEF PROCUREMENT OFFICER



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Expectations from passengers for the railway to become even greener are driving positive change across the industry.

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Q: How do you think sustainable concerns will shape the future of rail?

As the most environmentally-friendly mode of motorised transport, rail starts from a strong sustainability starting point. However, that doesn't mean that the rail industry should rest on its laurels. Recent severe weather events and the latest report from the Intergovernmental Panel on Climate Change have underlined that there is always more we can do to reduce our carbon footprint even further.

Expectations from passengers for the railway to become even greener are driving positive change across the industry. We're seeing key players such as networks and contractors ramping up their sustainability and carbon reduction policies, whilst rail infrastructure managers and suppliers play their part to improve the sustainability of track technology. Across the industry, organisations are responding to pressure from governments and their net zero targets as part of international climate change mitigation initiatives.

Q: Why is sustainability important in the context of rail infrastructure?

With awareness of climate change growing by the day, there has been a strong desire to move to a positive footprint for sustainable development in rail infrastructure.

Reducing the cost of track infrastructure is also hugely important. A major disincentive to train travel at the moment is the price of rail tickets – which is directly related to the overall cost of the railway. Improving infrastructure availability and durability will help to keep costs down and encourage more people to choose to travel by train rather than less environmentally-friendly, but currently cheaper, options.

Q: What does sustainability mean to Pandrol?

Sustainability is a key part of the Pandrol Promise we make to our customers. We commit to maximising safety, availability and sustainable lifetime value. We see sustainability as central to our work to meet global transportation needs for generations to come.

Q: Has Pandrol set any sustainability targets of its own?

As a market leader in rail fastenings, aluminothermic welding and rail infrastructure equipment, Pandrol must lead the way in the reduction of CO₂ and greenhouse gas emissions. Our ambition is that by 2024, Pandrol will act as the global example in the understanding and reduction of CO₂ and greenhouse gas emissions for rail infrastructure. Our goals have been set in line with the Paris Agreement of COP 21 and work towards achieving them has already begun.

Across all areas of our business, we are setting guidelines to reduce our carbon footprint. By 2023, we commit to achieving a 10% reduction on our 2019 greenhouse gas emissions. From switching our company cars to electric or hybrid vehicles, to evaluating the CO₂ emission of each and every component or raw material we purchase, our sustainable approach applies to all aspects of our supply chain.

Q: What are Pandrol's current sustainability initiatives?

We're rolling up our sleeves and getting stuck into initiatives such as measuring and reporting on our emissions levels, collaborating with working groups and strategic partners to reduce CO₂ and waste, plus conducting Environmental Product Declaration (EPD) analysis across three of our key product lines. But that's not all: we currently source almost 60% of our electricity for powering our plants from renewable energy, with plans underway to switch all of our energy to renewable sources.

We are committed to designing, installing and using products that, over their lifetime, need less maintenance and reduce carbon emissions. We also focus on recycling and reusing at the end of our products' life, for instance with nylon insulators which we are starting to recover, repurpose and reuse. Our aim in the long term is to create a circular economy at Pandrol.

We will continue to develop green products like our ground-breaking resin bonded rubber Sustainable Resilient Systems, which have achieved impressive Environmental Product Declarations. This year also sees the launch of our first independently certified, carbon neutral product, our Under Sleeper Pad range. We are sure it won't be our last.

Q: What's next for sustainability and the rail industry?

The rail industry has only just set off on a long journey of continuous improvement when it comes to sustainability. As a sector, we're developing greener products, addressing our practices and working hard to reduce our overall environmental impact.

What's next will be a broader focus on what sustainability means. Whilst green initiatives are key, we cannot build a sustainable future for the railway without also considering our social impact. At Pandrol, we are focusing on social initiatives for the communities of rail workers we are involved with, through delivering innovative training solutions.

As we look forward, we need real clarity in the way ahead for rail in order to deliver a viable future for global transportation.

On track to carbon neutral



Pandrol is proud to have received a world first CO₂-neutral label for our Under Sleeper Pad range.

Pandrol has underlined its commitment to working collaboratively towards global carbon neutrality, supporting certified climate projects across the world to reduce its total carbon impact.



“ We have taken action to reduce our environmental footprint for the products which can be most improved. ”

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.

Pandrol is fully committed to helping to reduce the impact of remaining CO₂ emissions from Under Sleeper Pad production by financing labelled green energy production projects in developing countries.

Pandrol's ambitious approach to this product has an outstanding impact, verified by Belgian-accredited inspection and certification organisation, Vinçotte. This commitment contributes to the collective goals of carbon neutrality Pandrol shares with many other organisations and companies across the world.

During their own life cycle, Under Sleeper Pads will also contribute to reducing the carbon footprint of railway lines, by increasing their lifespan and reducing the need for maintenance.

Thomas Lorent, Head of Sustainable Resilient Systems (SRS) at Pandrol, comments: "Last year, we took action to understand the carbon footprint of the Pandrol SRS products, conducting a full Life Cycle Assessment. Since then, we have taken action to reduce our environmental footprint for the products which can be most improved.

"This change will limit the carbon impact of our Under Sleeper Pads, allowing us to reduce our CO₂ emissions and support certified climate projects at the same time."

EMISSION-FREE INNOVATIONS

As part of Pandrol's E+ range of products, all showcasing their sustainability credentials, the CD100 B allows clipping machines to go emission-free.



CD100 B: Pandrol's battery powered clipping machine

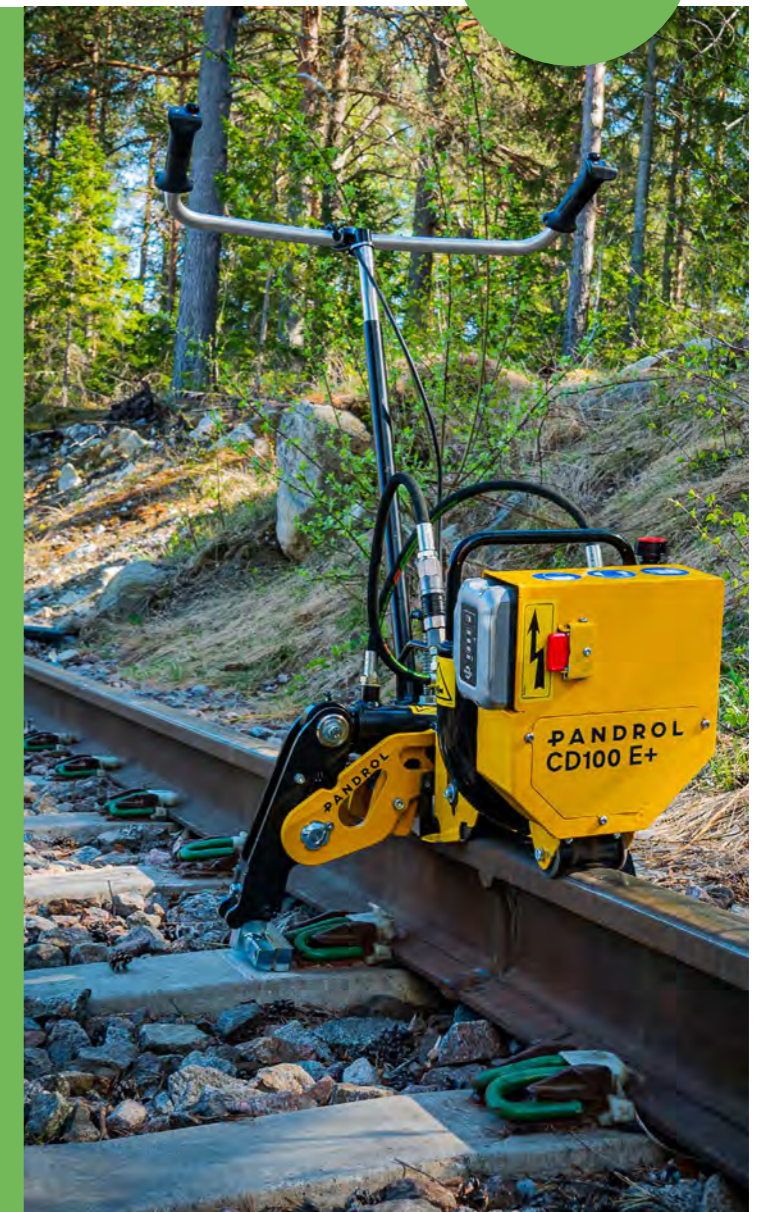
The CD100 B is an emission-free portable clipping machine designed for quick and easy clipping and declipping of the Pandrol FE, FC and FCX Fastclips.

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. As part of its ergonomic design, a weight-bearing wheel runs along the rail, dramatically reducing the physical strain on the operator and making it safer and more convenient to use.

The CD100 B power unit can be coupled to clipping and declipping equipment and is strong enough to lift a sleeper up to 10mm.

The CD100 B replaces the need for manual hand tools for small jobs, eliminating the risk of tools slipping and physical stress injuries. Powered by battery, this emission-free clipping machine is suitable for use in tunnels and stations and in densely populated areas where working safely with low noise and clean air is a priority.

Part of the Pandrol E+ range, optimising energy-efficient, environmentally-friendly track construction and maintenance, the CD100 B is designed to significantly cut carbon emissions without compromising power.



CASE STUDY

REDUCING AIR POLLUTION IN BANGKOK



Red Line Mass Transit, Bangkok, Thailand

CUSTOMER: State Railway of Thailand (SRT)

DATE: 2021

SECTOR: Mainline

EXPECTED DAILY COMMUTERS: 208,000 passengers

Like many cities worldwide, Bangkok needs a safe, efficient and cost-effective solution to get its 10 million people moving. With traffic congestion and air pollution major problems – 75% of public transport in the city currently depends on buses – State Railway of Thailand (SRT) was keen to create a mass rapid transit system that will encourage a shift from road to rail. Pandrol's SRS and DRS fastening solutions helped to make it happen.



CUSTOMER CHALLENGE

SRT began constructing its new Red Line suburban rail system back in January 2009. The system consists of two lines: the 26km Dark Red line linking the northern and southern parts of Bangkok, and the 15km Light Red service linking east and west. Parts of the lines passing through inner-city areas are elevated and there are four track and double track sections. The new Bang Sue Central Station – a 'mega-station' replacing the century-old Hua Lamphong Station – will act as a connecting hub for the lines. Now that it has been built, it is the biggest station in South East Asia.

We had already worked on parts of the city's mass rapid transit system run by Bangkok Mass Rapid Transport Authority (metro), including the Purple Line and Green Line South that were completed in 2016 and 2017, the Green Line North which opened at the end of 2020 and the Orange Line East, currently under construction.

When SRT was looking for solutions for its Red Line that combined ease and speed of installation with durability, reliability and long-term performance, Pandrol was the natural fit.

PANDROL SOLUTION

We provided our SRS and DRS fastening solutions for elevated sections of the Red Line, with Pandrol e-Clip used for ballasted sections. Like all of our fastening systems, these are an evolution of time-tested technologies, renowned for their safety and reliability. The SRS and DRS fastenings bring particular benefits in terms of insulation and noise and vibration mitigation, making them ideal for use in the city-centre setting. On ballasted track, our Under Sleeper Pads were used to reduce vibration levels in sensitive areas.

Our PLA one-shot crucible aluminothermic welding kits were used to weld the Red Line's long rail strings together, including for wide-gap welding. The solution provided is of the highest quality in South East Asia. The welding team from Worksop assisted with training in the use of the technology, including instruction and demonstration of products and equipment, and welder certification.

To support the Red Line's European Train Control System (ETCS) signalling, we supplied Pandrol Clamp Beams. This non-intrusive balise transponder mounting system uses the rail fastenings to hold the beam in track, eliminating the need to drill

sleepers or dig out ballast. As a result, installation typically takes less than five minutes per balise. Once installed, the beam is completely insulated, vibration resistant, strong and durable, ensuring a long life on the Red Line.

For the Red Line depot, we supplied and designed the retractable rigid catenary system for the electrification. Adapted, reliable and secure, this will allow work to take place in safety and ease maintenance operations on trains. In addition, the Pandrol FR fastening system was used in the depot – an elastic fastening that brings benefits in terms of vibration attenuation, creep resistance and electrical insulation. The assembly is designed for long life, can be fully dismantled for inspection and maintenance, and all parts are replaceable.

Our non-intrusive balise transponder mounting system uses the rail fastenings to hold the beam in track, eliminating the need to drill



THE RESULTS

The Red Line – along with Bang Sue Central Station – is now finished, with a soft opening launched in August 2022. Commuters will be able to ride along the Red Line for free until November, when full commercial services are expected to begin. The line will be used by both Red Line commuter trains and long-distance services and is expected to carry in the region of 208,000 commuters a day.

Three extensions for the Red Line are now being planned, along with a high-speed link between Bang Sue Central and three nearby airports.

All of this marks a greener and cleaner way for Bangkok to commute and travel, keeping the city connected whilst improving air quality.

PANDROL ADVANCED:

changing the game for welding

Our new Pandrol Advanced welding process harnesses innovation every step of the way.

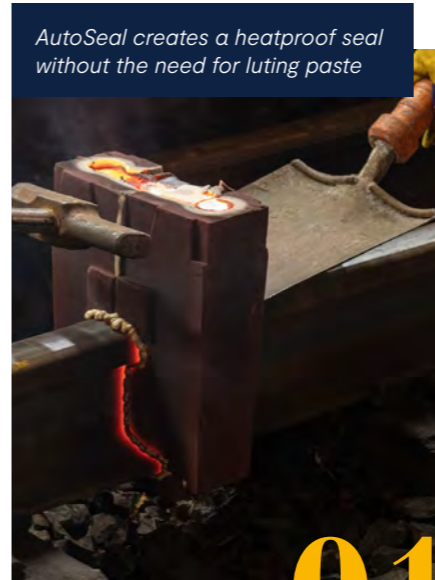
As a standard-setting rail technology company, Pandrol is constantly driving industry innovations – leading the way on everything from environmental responsibility to technical best practice across the board.



PRE-ASSEMBLY IN PRACTICE

As part of its enduring commitment to sustainability, Pandrol is taking steps towards improving its world-leading welding process. Having realised that the process itself had undergone minimal change since initial implementation, Pandrol spent time analysing its efficiency in terms of time, safety, accuracy and environmental impact. Armed with these insights, the organisation was equipped to create Pandrol Advanced, a brand-new process for better, more effective welding.

Pandrol Advanced harnesses innovation at every step of the welding process to save time and improve safety, ergonomics and weld quality.



AutoSeal creates a heatproof seal without the need for luting paste

INNOVATION 01 AUTOSEAL MOULD

Aluminothermic welding traditionally involves luting – sealing moulds to rail ends with paste or sand to avoid metal leaks. But with Pandrol Advanced, the luting process is replaced by AutoSeal, the world's first self-sealing mould. AutoSeal comes with a built-in insulation joint that expands during pre-heating to create a tight seal when fitted onto the rail.

AutoSeal offers a number of key benefits that serve to make the entire welding process more efficient. Firstly, it reduces the time spent on each weld by a minimum of five minutes, thanks to its ability to automatically seal the mould and eliminate the need for luting. This moulding system also makes sealing more reliable, lowers the defect rate by evacuating moisture during preheat, and puts welders' health first by reducing the time they need to spend kneeling. AutoSeal also means less plastic waste, lower energy requirements and a reduction in overall environmental impact – making it a highly efficient alternative to traditional methods of welding.

INNOVATION 02 HIGH FLOW PREHEATER

Fully optimised for use with Pandrol's High Flow Preheater (HFP) – the universal preheating system brought in to replace all current equipment – the Advanced process raises the parent steel's temperature prior to welding. As opposed to the mix of oxygen and propane used by most existing preheating systems, the HFP uses pure propane, eliminating the cost of oxygen and improving the welders' onsite experience thanks to the equipment's lower weight and smaller canister. And with the ignition, timing and stop all fully automated, there's no need for lengthy manual interference or flame adjustment.



The battery-powered High Flow Preheater (HFP) in use

As Frédéric Delcroix, Pandrol's Welding Technical Director, explains: "Our High Flow Preheater's built-in timer increases accuracy – improving quality and reducing the defect rate of welds due to preheating, which can be a real problem for rail operators. By providing a uniform preheat between the head and bottom of the rail, the High Flow Preheater reduces stress in the weld. We've also made it easier to operate; there's no need to adjust the torch height, which saves time, and as the system is fully automated, less training is required. It is straightforward for new welders to learn to operate, and offers the added reassurance that comes from knowing the preheat has been even."



The Pandrol Connect app in use

INNOVATION 04 PANDROL CONNECT APP

With the Pandrol Connect welding app giving welders the ability to manage the entire Advanced process digitally from their device, the method is more effective and environmentally efficient than ever. This technology means that instead of recording data manually, welders can input information straight into the app before, during and after welding, with reviewing carried out by welding controllers and monitored from the office.

The Pandrol Advanced process is paving the way for innovations across the board in condition and maintenance. With fit-for-purpose practices such as the AutoSeal mould, HFP and CJ1 crucible used throughout, the process has redefined what's possible when it comes to environmental responsibility and efficiency in the welding process. From its position at the cutting edge of welding technology, the future looks bright for Pandrol – and for all those who follow our example.



The CJ1 crucible, pre-installed with a Startwel® electronic ignition system

INNOVATION 03 CJ1 ONE-SHOT CRUCIBLE

The Pandrol Advanced process also selects the smaller, CJ1 one-shot crucible rather than the larger CJ2 version, making it suitable for all standard gap and head wash repair welds, which accounted for 98.5% of all welds cast by Pandrol in the UK in 2019. Thanks to pre-installation conducted by a Startwel® electronic ignition system, the CJ1 design makes igniting the portion within the crucible safer and easier. Using it as part of the Pandrol Advanced process also reduces waste, cost and requirements for packaging and transportation due to its lighter weight and non-explosive classification.

CASE STUDY

HIGH FLOW PREHEATER MAKES ITS DÉBUT IN MONGOLIA



Tavantolgoi–Gashuunsukhait Railway, Mongolia

CUSTOMER: Bodi Group/InCon

DATE: 2021

SECTOR: Heavy Haul

TRACK LENGTH: 240km

The Tavantolgoi–Gashuunsukhait Railway – approximately 240km long, with two stations and five passing loops – is set to be enormously significant for Mongolia’s economy. This new railway will allow Mongolia to increase its export capacity by 30 million tons of coking and thermal coal annually. As a result, the country’s mining companies will be able to compete in the global market for cheaper exports, supporting both coal exports and China’s ports.

Despite the project taking place during the ongoing Covid-19 outbreak, Pandrol’s commitment to social sustainability allowed us to deliver innovative training solutions to upskill the team of welders in Mongolia, future-proofing their rail network.

CUSTOMER CHALLENGE

To complete the Tavantolgoi–Gashuunsukhait railway project, Bodi Group (one of the largest business groups in Mongolia) and its subcontractor InCon were looking for a great value welding solution that was versatile and reliable. They turned to Pandrol for the solution and awarded the contract in early 2020, just before the onset of the pandemic.

Pandrol’s aluminothermic welding product was used for hard-to-reach places such as switches and crossings,

stressing points and any remedial works. Versatility was key in these areas, which made Pandrol’s reliable, flexible aluminothermic welding product the perfect solution.

Under normal circumstances, a member of Pandrol’s specialist welding team would have travelled to Mongolia to carry out in-person training. However, border closures and travel restrictions made this impossible.

PANDROL SOLUTION

From July until September 2020, Pandrol supplied the aluminothermic welding kits and conducted online training. With the High Flow Preheater (HFP) not ready for use at this time, Pandrol employed a traditional oxy propane preheating method, training the teams in Mongolia to use it correctly. This was a challenging phase of the project due to the equipment’s sensitive nature and the team’s lack of experience in this area.

Fish plates are usually used to secure tracks in Mongolia and the team on-site hadn’t seen pre-heating or used welding techniques before. With Covid-19 preventing in-person training, Pandrol delivered bespoke, virtual training to seven railway workers in Mongolia. Supported by a translator, the trainees spent three weeks learning how to weld and how to use the Pandrol equipment, both in a training environment and in situ on track. Teaching welders how to use the oxy propane preheating equipment virtually proved particularly difficult – its large flame can be disconcerting for new welders, and its high temperature can induce nerves at first.

Following the training, each employee shipped a test weld to Pandrol’s headquarters in France for quality checks and certification. All welds passed the European inspection criteria – however, some of the welds were showing signs of overheating due to the use and set up of the oxy propane equipment. Pandrol presented the results

to the team in Mongolia, identified that the preheating process in place needed improvement, and discussed the best solution.

By this point, Pandrol had launched the Electric 230V HFP (High Flow Preheater) – a universal preheating system that raises the temperature of the parent steel before welding. Fully automated for easier, more reliable operation, the ignition, timing and stop are automatic and require no manual interference or flame adjustment. Using propane rather than oxygen and propane mixed reduces costs and makes the equipment light and portable.

The team in Mongolia was instantly impressed with the product, recognising that it would put welders instantly at ease and remove safety risks. Almost a year after the contract was first signed, in March 2021, the HFPs were manufactured, shipped and delivered. The Pandrol team conducted HFP training, which resulted in an instant improvement in the welding quality. This was a fast, easy solution that empowered the Mongolian team to do the best possible job.

As Frédéric Delcroix, Pandrol’s Welding Technical Director, explains: “Our High Flow Preheater’s built-in timer increases accuracy – improving quality and reducing the defect rate of welds due to preheating, which can be a real problem for rail operators. By providing a uniform

preheat between the head and bottom of the rail, the High Flow Preheater reduces stress in the weld. We’ve also made it easier to operate; there is no need to adjust the torch height, which saves time and as the system is fully automated, less training is required. It is straightforward for new welders to learn to operate and offers the added reassurance that comes from knowing the preheat has been even.”

The customer, Bodi Group, also praised the HFP system: “We use new HFP equipment all the time and it greatly simplifies our work. Thank you for providing this new technology.”



THE RESULTS

Welding has continued successfully, and rapid progress is being made on the Tavantolgoi–Gashuunsukhait railway. In 2021, more than 1,100 plated joints were welded on the main track using the Pandrol HFP preheating system, with zero failures. This year, the team is planning to weld another 700 joints on the turnouts.

Using the HFP ensured completed welds were consistently better quality, more accurate and highly reliable. The solution was delivered purely to help the teams in Mongolia, offering peace of mind, confidence and assurance for welders without experience of oxy propane methods. The coaching we delivered allows track workers to preheat effectively with very little training.

As Chris McKeown, Head of Operations for Aluminothermic Welding & Equipment for Pandrol UK notes, this has been a successful project on multiple levels: “It just goes to show that when we’re faced with challenges, we can be agile – bringing innovative ways of working to the table to the benefit of client outcomes.”

FILLING THE GAP:

the welding skill shortage

Around the world, the rail industry faces a huge shortfall in track workers, including welders. Pandrol is taking action!

According to the American Welding Society, the industry will reach a deficit of 400,000 workers by 2024. A rapidly ageing welding workforce, as well as some misconceptions about careers in rail, are contributing factors in the labour shortages. Although automation and new technology are helping to bridge the gap in some areas, there is still a demand for track welders everywhere in the world.

ON TRACK WITH TRAINING

At Pandrol, we have been encouraging young people to consider starting their career in welding by working with Railway Civil Engineering students in Universities in Paris, Valenciennes and Lille (France) to offer training in aluminothermic rail welding.

In addition to this outreach work, we have our own training academy – a 5,000m² facility which was launched thirty years ago in Raismes, France. Internal and external tracks are used to provide a classroom environment and replicate on-track conditions, with all welding completed outside. In addition to a standard track, there is a third rail dedicated track and this year will see the installation of a crossing for training of ARC repair. The training also supports the introduction of digitisation in track welding using the Pandrol Connect weld traceability app.

Training can range from two weeks to a full six weeks for total beginners. It can be complemented by e-learning and tutorials, like the 'how to' series on the Pandrol website and the AND ANOTHER THING podcast. Over 200 people are trained each year on the different processes.

MORE NEEDS TO BE DONE!

The Pandrol Training Academy is definitely a step in the right direction. As well as training welders on site, it leads and supports our other training centres around the world, in countries including Indonesia, China, Australia, USA, Canada, Thailand, Mexico, Brazil, India, South Africa, Germany, Austria, Russia, UK, Spain, the Czech Republic and Morocco. In addition, it trains remote welding trainers to travel to different locations.

However, as Nicolas Chevalier, Head of the Pandrol Training Academy explains, more needs to be done. "Statistics paint a gloomy picture for the future of talent in the rail industry, with huge numbers of skilled workers leaving over the next few years without a solid base of new recruits to replace them.

"The industry needs to do more to raise awareness of the opportunities that are available and challenge the preconceptions many may have of a career in rail. There are plenty of large-scale rail projects happening round the world, so there is a growing demand for talented welders and skilled track workers.

"The training team at our Training Academy travels all over the world teaching welding to track teams. Many of us started out welding on track and have seen the industry change and grow first hand – it's a really exciting time to be a part of it!"



Noise and vibration

We now live in a world where urban dwellers are living in close proximity to the rail network, while demands from consumers become increasingly pressured. But the more we develop high speed rail, light transit and other urban rail in our cities, the more that noise and vibration become significant challenges.



At Pandrol we're dedicated to not only mitigating noise and vibration, but also understanding this issue on a deeper level. Only then can we design and develop products to meet our railway's ever-changing needs today and into the future.

PRODUCT PROFILE:

Bonded DFF System

Bonded DFF – Pandrol’s resilient bonded baseplate solution – is ideal for use when high levels of vibration mitigation are needed.

USAGE

The Bonded DFF system can be used on both standard track and turnouts. Suitable interfaces include pre-cast concrete slab panels, pre-cast concrete sleepers, direct pour concrete, and steel structures.

ASSEMBLY

Top and bottom baseplates are factory assembled into a one-piece system bonded together using vulcanised rubber.

INSTALLATION

The system is quick and easy for one person to install within safe working limits.



ELECTRICAL RESISTANCE

The system’s vulcanised rubber bonding achieves high levels of electrical resistance and a long electrical leakage path. It offers insulation for the rail, isolating it from the track bed and avoiding electrical leakage into the ground, as well as a high level of stray current protection.

CORROSION RESISTANCE

The vulcanised rubber covering acts as a protective barrier between the baseplate and the atmosphere.

TEMPERATURE RESISTANCE

In high temperatures, the use of Bonded DFF reduces the stress in the rail.

DURABILITY

The assembly has a fail-safe design, remaining active and safe, should bond failure between rubber and metal components occur.

STIFFNESS

Bonded DFF provides both vertical and lateral stiffness via its two independently cast baseplates. An engineered bonded rubber substrate linking the two plates provides the required stiffness performance.

VIBRATION MITIGATION

Bonded DFF decreases the dynamic load level by reducing vibrations transmitted to the ground and distributing them along the supports. As a result, vibrations are isolated, and the secondary noise generated by the transmission of these vibrations through the surrounding structures can be mitigated.



BONDED DFF – THE LATEST NEWS!

Over the past 18 months, the Fastening Systems team has been busy developing the Bonded DFF product range.

The product is available in a range of stiffnesses, developed to meet the demands of specific projects. The stiffness range covered by the DFF product range is capable of meeting the performance demands of modern railway projects. There is a tendency within the industry for very specific stiffness requirements to be stipulated in performance specifications. In practice, these small incremental differences in stiffness performance are not required as they produce an insignificant change in overall system performance. The challenge is better informing the industry on the selection process for these products to avoid the need to supply variants of product performance that are unnecessary and not helpful to the product’s carbon footprint.

Recently, a new acoustic standard has been released and is being included alongside vibration requirements in technical performance specifications. The Bonded DFF system is required to perform to a specific standard in relation to the radiated noise created by vibration disappearing into structures and reappearing as secondary noise (e.g. windows rattling in a house over an underground train station).

This new standard has been achieved with the K6 (6kN/mm) baseplate in order to meet the needs of the Sydney Metro in Australia. Experts from the Technical Fastenings section in EMEA devised and manufactured a concept solution with the initial manufacture being undertaken through the Pandrol APAC group. The system was then tested to the new standard using a specialist testing agency in North America through the Pandrol North America team.

A great example of One Pandrol in action! These same acoustic improvements will now be implemented across the rest of the DFF range.

CONFIGURATIONS

Bonded DFF is available as an offset configuration for both two and four bolt arrangements, as well as a two hole in-line configuration, making it ideal for new build, track renewal and retrofit applications. It is also available in a variety of lengths, for use in plain track and with options to suit all turnout applications.

CLIP TYPES

The system is available with a variety of clip types, including e-Clip, SD, SLK, Nabla and FE.

CUSTOMISED PRODUCTS

Customised models are designed for switching zones, allowing a single fastening system to be used for the whole track. Pandrol can provide Bonded DFF products with performance characteristics to suit individual customer specifications.



CASE STUDY

PANDROL'S DOUBLE SOLUTION FOR THE SYDNEY TRAMWAY



Sydney Light Rail, Australia

CUSTOMER: Sydney Tramway, Australia

DATE: 2018

SECTOR: Metro & depot

TRACK LENGTH: 13km

The CBD and South East Light Rail is a new light rail network for Sydney, with a 12km route and 19 stops. Sydney Light Rail also incorporates the Inner West Light Rail which is now operating as the L1 Dulwich Hill Line – a 12.7 km route that connects to Central Station and is used by 9.8 million customers every year. It is expected that the expanded light rail network will significantly improve public transport access to major sporting and entertainment facilities.

In this demanding city-centre project, vibration mitigation was key to ensure minimised disruption to local residents. Pandrol rose to the challenge by providing solutions including Qtrack® and Floating Slab Mats (FSM).

CUSTOMER CHALLENGE

Due to its central location, the project required an innovative and flexible approach, including the necessity of a fast and forward installation taking place over weekends which could guarantee a minimal interruption of the busy streets. Pandrol was appointed to this project in 2016, working alongside infrastructure contractor Acciona. The main technical challenges lay in the need to mitigate the ground-borne vibration issues of a project located in the Central Business

District of Sydney, and the high electrical stray current isolation that was required.

A further requirement challenge was the high demand for large volumes and the need for great flexibility in the delivery programme. Pandrol met this challenge by increasing factory production capacity, establishing several production moulds to work in parallel with each other.

PANDROL SOLUTION

Pandrol solved these challenging project requirements by engineering a combined solution of two systems: Pandrol Qtrack® and Pandrol Floating Slab Mats (FSM) which provided the perfect solution for work in a congested urban environment. Pandrol was chosen because of the company's high capacity for production – required on such a large volume project and also because of Pandrol's extensive global experience and the confidence of Acciona in its products.

The Pandrol QTrack® system was specified for the Sydney Tramway, which is a continuously supported and fastened embedded slab track system. The rail is encapsulated by elastic resin bonded rubber profiles which provide a broad range of benefits, such as vibration mitigation and electrical isolation –

both issues of great importance for this project. Pandrol has developed a specialist solution to issues with stray current named QT ELEC. The QT ELEC is an electrical insulating film used on the Sydney tramway project.

Pandrol QTrack® is renowned for being easy to install and the Pandrol team provided technical support throughout the process, from design to installation stage. On-site training was also provided by the Pandrol team from Hoeilaart, in Belgium.

The system is widely recognised as a cost effective and long-lasting performance solution. It is consistent with the need to reduce ground-borne noise and vibration, and is compatible with special track works such as drainage and electrical

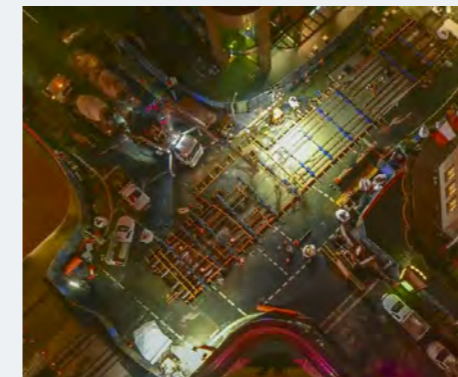
boxes, insulation joints, axle counters, switches and crossings, and other typical depot equipment. It is compatible with the need for sustainability as it includes few components and is therefore eco-friendly. Pandrol QTrack® is renowned for being durable and maintenance-free and offers reduced lifecycle costs. It is available for grooved and Vignola rails for different axle loads: LRT, Metro, Train, High Speed and Heavy Haul.

Pandrol QTrack® system was supplied in two different versions: XP and HP. XP covered the larger amount of track, almost 19 kilometres, where as the HP version of QTrack® was used over 10 kilometres. Pandrol FSM was also specified in FSM-L13 and FSM-L4.5 systems, adapting to the level of vibration mitigation required by the project.

THE RESULTS

The success of the project resulted in a new line which will serve the busiest areas in downtown Sydney from Circular Quay at the northern end of the Central Business District along George St and to the south-eastern suburbs of Randwick and Kingsford.

This was a high volume, demanding project, with great flexibility required in the planning process. The successful conclusion of the project demonstrates Pandrol's innovative approach to working proactively with the customer, and delivering high volumes to meet project requirements.



Innovation in urban integration

Pandrol's latest innovations in track design are helping residents in towns and cities to live in harmony with the railways.

Over the past century, the world has experienced a dramatic growth in urbanisation. The number of people living in towns and cities rose from 751 million in 1950 to 4.2 billion by 2018 – over half the world's total population. Inevitably, these communities need transport, and train, tram and metro networks offer the most sustainable, efficient solution. However, their associated noise and vibration can create issues for the people living and working alongside them, particularly when services are frequent and run 24 hours a day.

WHAT CAUSES NOISE AND VIBRATION?

The founding principle of rail transport is the low-friction, steel-to-steel solid contact between wheel and rail. It is this which makes rail transport so efficient, resulting in low maintenance and high axle load. However, it is also the cause of its greatest problem – noise and vibration.

In urban rail networks, direct noise is primarily due to the rolling sound produced by train wheels and track as they vibrate. This noise travels through the air, from the railway line to the ears of anyone nearby.

In addition, the vibration produced by the solid contact between the steel of the wheels and the steel of the track goes into the ground and travels to nearby buildings, where it is converted into secondary, 'structure-borne' noise. Walls and floors

vibrate and act as giant loudspeakers, creating a problem for trackside neighbours – even with closed windows!

With brand new track and rolling stock the noise is likely to be minimal. However, as soon as there are even slight imperfections in the geometry and surface of the wheel or of the track, vibrations arise and local residents' complaints grow.

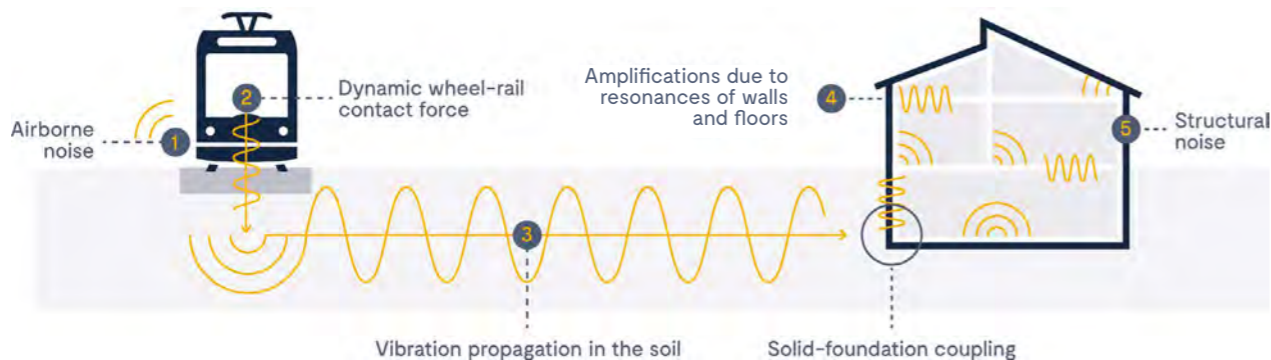
The most common noise is the 'tac-tac' sound produced when a train runs over a local defect on the track. There are several potential causes: wheel slips creating a small indentation in the rail; a poorly welded or ground rail; or a rail fixed with fish plates leading to a rail head defect.

Wheel slips – often caused by drivers braking too hard and leaves on the line – can also lead to wheel flats, which create

a 'thump-thump-thump' noise as the damaged wheels run over the hard rail.

In addition, curves in the track and bridges and viaducts can create noise and vibration issues for those living nearby. In the case of bridges and viaducts, vibration is transmitted into the structure, producing noise that then travels through the air to the people below and alongside. Inaccuracies in the track geometry and the gaps and alignment changes created by switches and crossings can also become a significant source of noise and vibration.

Whatever the cause of the problem, once residents are sensitised to the noise and vibration levels affecting their properties, there needs to be a significant step change to mitigate the disturbance.



Tackling the problem

At track level, there are four ways to limit noise and vibration annoyance for neighbours:

- Deliver a new state-of-the-art rail system.
- Monitor and maintain the rail system.
- Reduce track degradation by adding track resilience.
- Mitigate noise and vibration.

In general, prevention is far better than cure! The best way to mitigate the impact of noise and vibration is to integrate countermeasures into the design of any new or upgraded track.

As this suggests, noise and vibration mitigation should always be a key consideration when building new tramways, railways and metro systems. Construction needs to be carried out carefully to avoid local defects generating noise and vibration, with a focus on smooth track geometry, good wheel design and rail interaction, and effective welding and grinding of the rails. In addition, some resilience is generally built into modern track to attenuate the transfer of dynamic forces from the wheel and rail to the track support, and this provides an initial quality that helps to avoid generating vibrations.

MONITORING TRACK AND WHEEL QUALITY

Maintaining the quality and geometry of the track is essential for the mitigation of noise and vibration. To achieve this, the condition of the track needs to be constantly monitored and any maintenance and repairs carried out efficiently. This reduces the vibration and prevents faults worsening and causing secondary issues. Solutions like Pandrol's Head Wash Repair welding process are proving particularly successful in this context, enabling the quick, cost-effective repair of defects and flash butt welds.

In addition, active wheel monitoring must be carried out to ensure train wheelsets are in a good state of repair and will not damage the track.

USING RESILIENCE TO CONTROL TRACK QUALITY

Introducing an elastic medium with specific spring characteristics – a resilient system – can also help to maintain high quality over the lifetime of the track. Pandrol's Under Sleeper Pads (USP), for example, increase the quality of ballasted track by improving ballast contact, reducing maintenance and providing vibration mitigation through fixing elastic elements to the bottom surface of the sleepers.

Having a well-defined stiffness and/or continuous support for the rail also reduces rail corrugation, the subsequent increase in vibration and the need for maintenance grinding. This can be achieved by utilising the continuous support offered by the Pandrol QTrack system®, or high resilience baseplate systems like Pandrol's Vanguard and Bonded DFF solutions.

ISOLATING TRACK TO REDUCE VIBRATION TRANSMISSION

Creating a mass spring system can further mitigate noise and vibration. As a result of the introduction of an elastic medium with specific spring and damping characteristics, vibration energy remains in the track and is not transmitted to neighbours.

Various levels of vibration reduction can be achieved, using methods ranging from the introduction of soft fasteners through to the integration of very soft floating slab track, depending on specific design requirements and conditions.

Pandrol's soft solutions include Vipa, Bonded DFF and DEE baseplates, and Booted Block and Under Sleeper Pads. These help to reduce impact and vibration in urban areas with low to medium requirements. Soft Under Ballast Mats offer an alternative for ballasted track.

For many metros, the preferred solution is Pandrol's Vipa DRS system, which is suitable for installation on non-ballasted track and in areas where a reduction in vibration and secondary noise is required. This features a Pandrol e-Clip baseplate mounted on a studded natural rubber pad that provides the system resilience. The configuration can be tuned within limits to meet requirements for axle loads and stiffness. Vipa DRS has been installed in major cities around the world, including Bangkok, Chennai, Delhi, Dubai, Hong Kong, Istanbul, Kolkata, Kuala Lumpur, Sao Paulo, Seoul and Singapore.

For higher attenuation requirements, Pandrol's Vanguard and Floating Slab Mat (FSM) systems are recommended.

To monitor the effectiveness of our solutions, Pandrol developed Track Elastic Model (TEM) software. This can be used to simulate conditions at the transition between two different types of track, enabling us to smooth the design and avoid local degradation and resultant increased vibrations.



Products in focus

PANDROL VANGUARD

Our Vanguard rail fastening system has very low vertical dynamic stiffness, resulting in high levels of vibration isolation. A low-profile system, it can easily be retrofitted with various footprint designs and offers high levels of lateral and vertical adjustment. Cities worldwide – including Barcelona, Madrid, Milan, London, Stockholm, Sydney, Sao Paulo, Philadelphia and Boston – have implemented retrofit installations on their railways using Vanguard. In many cases, this has been enough to reduce noise and vibration to a barely perceptible level, eliminating residents' complaints completely.

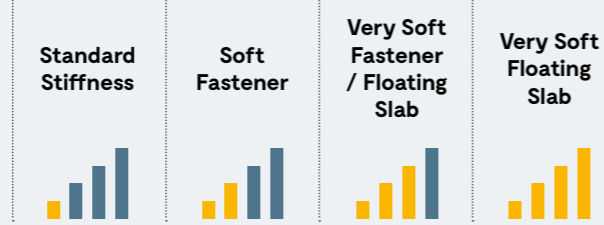
PANDROL FLOATING SLAB MATS AND PADS

Floating Slab Mats (FSMs) are installed below the slab track to create a very efficient mass spring system. Working perfectly with both fully-loaded vehicles in daytime and empty vehicles at night, FSMs provide excellent noise and vibration mitigation.

A number of cities have implemented the FSM solution, including Chennai, Sydney, Portland, Los Angeles, Toronto, Athens, Lisbon, Madrid, Roma, Milan, Florence, Bergen, Budapest, Szeged, Sofia, Algiers, Casablanca, Rio and Santiago. In Belgium, for example, the Brussels Tramway STIB-MIVB installed over 150,000m² of FSMs in its busy urban sectors. Demands were extremely high, as local residents regularly complained about tram noise and vibration in the city's busy, narrow streets. Since the solution was implemented, complaints have been minimal.

Floating Slab Pads offer an alternative solution for the most demanding areas, with softer pads being substituted for the resilient mats to create an even more efficient mass spring system. This solution is more expensive as it requires the use of precast slab track, but it provides a premium level of vibration mitigation and a system that is easy to install and renew. In use in Barcelona since the late 1990s, the system is particularly appropriate for highly demanding tunnel projects.

PANDROL NOISE AND VIBRATION SOLUTIONS



METAL



POLYMER



RUBBER CONCRETE



High speed

As more and more countries around the world are investing funds, technology and resources into high speed rail, governments the world over are recognising the significance of high speed as the future of transport.



CONCLUSION

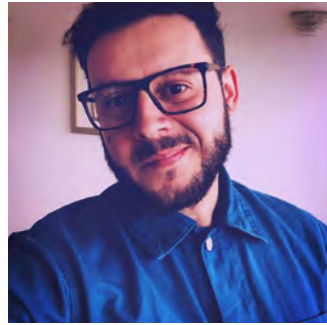
As urbanisation continues to increase, rail transport lies at the heart of the need to reduce traffic congestion and help the four billion people who live in towns and cities move around in a sustainable way. As a result, minimising the noise and vibration created by urban railways, trams and metros is essential.

As this article suggests, good design and maintenance are key. Moving forward, our industry needs to ensure effective noise and vibration solutions are integrated within new and existing rail networks from the outset, to enable people to live peacefully alongside the railway.

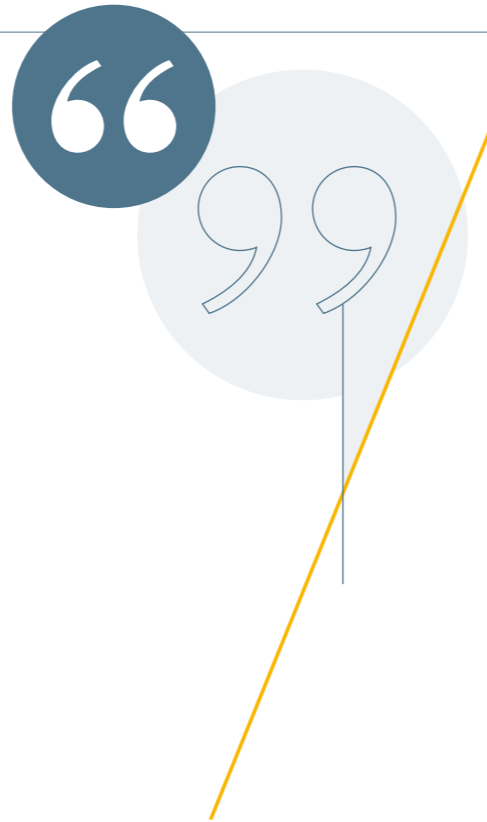
At Pandrol, we are proud to be the only company worldwide which can provide all types of fastening systems for high speed rail, whether threaded or unthreaded. The world speed record on ballasted track was achieved with Pandrol fastening systems at 574.8 km/h, and we are looking forward to breaking more ground.

ASK THE EXPERT:

Robotic assembly



MIHAI BARATOIU
ROBOTICS AND AUTOMATION ENGINEER



Q: How do you see the role of robotics in railways?

The emergence of robotics in manufacturing has created opportunities for businesses in every sector to reduce operating costs, as well as providing safer, more reliable and more efficient manufacturing processes. Within the railway sector, there is a real opportunity for automation and robotics to solve the most frequent, repetitive, dirty and hazardous tasks – both on track and in manufacturing facilities. The use of robotic assembly is set to become increasingly influential in high speed rail, with its particular demands for quality and accuracy.

Q: Which problems do you think robotics can solve?

Historically, robotics has been used to help businesses tackle problems around repetitive, strenuous and hazardous tasks. In the rail industry, robotics can be implemented to address a range of issues, including:

- Health and safety – recent studies have shown that most severe accidents occur while performing on-track maintenance operations. This is a real opportunity for robotics and automation to create a safer environment for railway employees.
- Ageing workforce and employment challenges – there have been issues

around staff shortages in the industry, with a particular shortfall in the UK as a result of Brexit.

- Track assembly manufacturing – using modular manufacturing processes to build and assemble track off-site, in a more controlled factory environment, can minimise time spent carrying out assembly on track.

Q: Which area of railway infrastructure do you predict will be the first to adopt robotics?

Suppliers of railway components have already implemented robotics for a range of processes within their manufacturing facilities, including clip painting, inspection and forming, and baseplate pick-and-place application.

Given the issues around on-track health and safety and shortage of staff, robotics adoption now looks set to increase rapidly for on-track tasks, such as maintenance, inspection and welding.

Q: Do you sense a reluctance to adopt robotics from the industry? If so, why?

There is certainly a reluctance in relation to on-track tasks. This is largely due to challenges created by track accessibility and weather conditions – performing on-

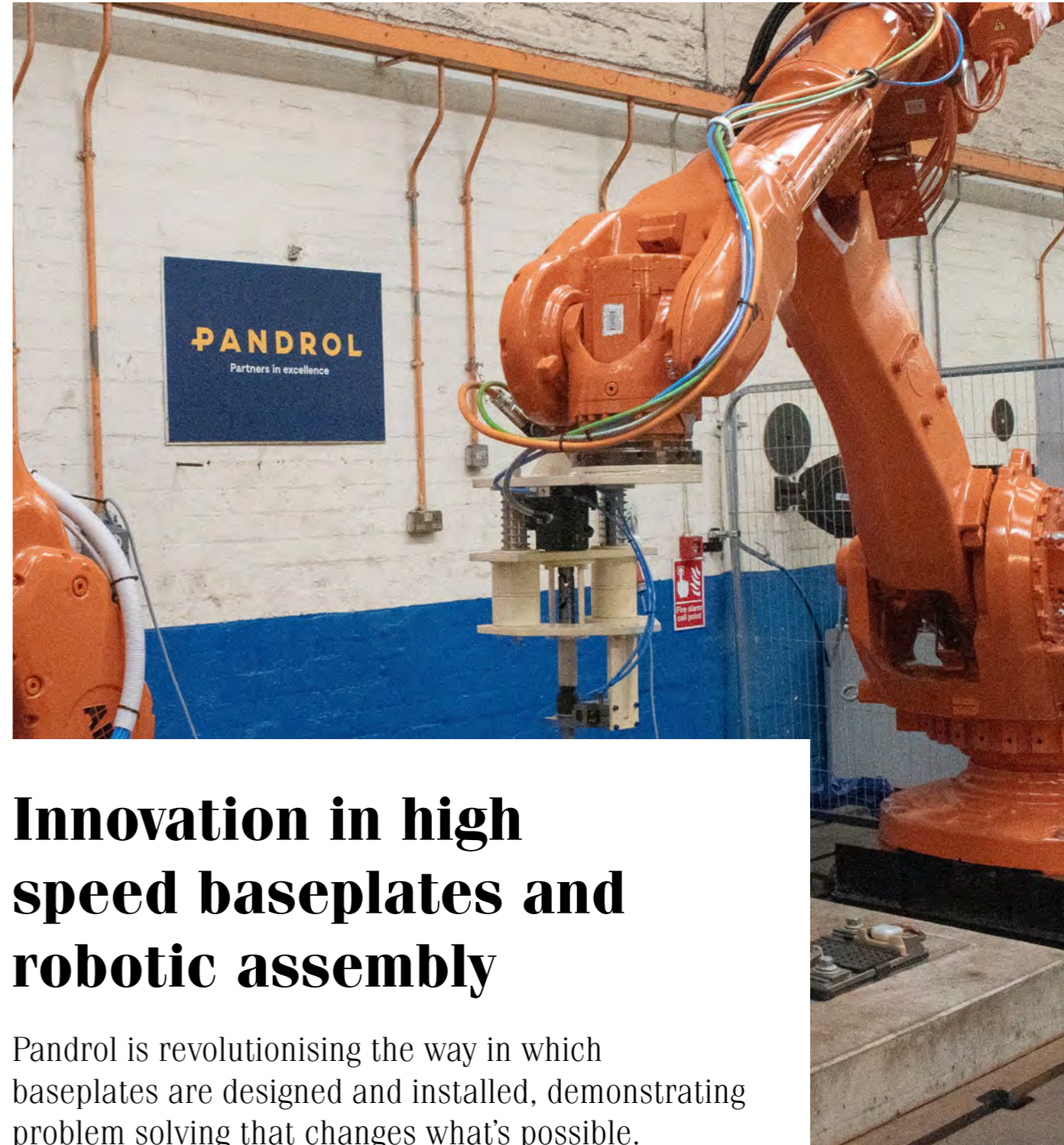
track maintenance on a rail section requires a tremendous amount of planning and skill. Automating this will be an interesting problem to solve.

Current track layouts also make it challenging for generic industrial robotics to be implemented as an off-the-shelf solution. Most robots are designed for use within a factory, where environmental conditions are known or at least predictable. Performing on-track maintenance or inspection tasks requires research and development into integrating known robotics with existing train structures. Only by doing this will hybrid solutions be developed that are suitable for performing outdoor tasks, thus minimising operator exposure to high voltage and other track-related risks.

Q: Do you think it will be possible to make the leap to fully automated maintenance in the future?

Current technology does not allow robotics or AI to have the same sensory capabilities or intelligence as human beings. However, progress in these areas looks set to increase exponentially in the coming years, bringing us closer to more autonomous solutions in the rail industry. For example, in the future using machine learning and AI is likely to help us make more accurate downtime predictions and plan ahead to mitigate the impact of things going wrong – although railway employees will still be needed to make the more complicated decisions.

HIGH SPEED



Innovation in high speed baseplates and robotic assembly

Pandrol is revolutionising the way in which baseplates are designed and installed, demonstrating problem solving that changes what's possible.

For high speed train operation, accurate alignment of the track is of the utmost importance. Where the possibility of significant levels of settlement after construction exists, or where seismic activity is likely, there will be particularly demanding requirements on the range and accuracy available for vertical and lateral adjustment of the rails. When the track is a non-ballasted track form, typically all of this adjustment must be provided for in the fastening system. Given the short periods available for maintenance, the accuracy, ease and speed with which these adjustments can be made are key attributes of the fastening system.



Pandrol has applied its design and development capabilities to reduce the time taken to make adjustments, the number of parts to be exchanged and the complexity of this important maintenance operation.

MADE FOR HIGH SPEED

The Pandrol Fastclip Baseplate is well suited to high speed. Adjustment is a fundamental requirement and there are several aspects. The range over which adjustments can be made in both vertical and lateral directions; the accuracy with which this can be done; the ease and speed of adjustment and the number and complexity of any additional or exchange parts are all important.

Adjustment may be required on curved track made up of short straight panels, as the position of the fastenings clearly needs to be offset to achieve a smooth alignment. This applies particularly to the lateral baseplate position and becomes more of an issue the tighter the curve. The fastenings must be positioned very accurately to achieve the tight tolerances on track gauge required on high speed track.

The baseplate can be tightened down and held firmly in position at the exact location required. The baseplates can also be slewed slightly relative to the axis of the slab, so that each baseplate is aligned exactly towards the centre of the curve of that the particular slab. This means that every slab can be identical and every fastening can be identically configured. Only the exact positions of the baseplates fitted to any one slab differentiate it from other slabs in the track. So 'spare' slabs needed for repairs are universal and do not need to be purposely constructed with the associated difficulties and lead times. Nor are any bespoke fastening configurations required to achieve exact track alignment.

EXACT PRECISION

High speed lines built in earthquake zones such as Japan and Taiwan have in the past led to a need for relatively high levels of vertical adjustment – typically +50mm. For HS2 in London, the requirement is even greater at +70mm. The difference may not seem large, but the overturning moment that acts on the fastening is greater and any concrete upstands provided to react to lateral loads are further from the top level of prestressing or reinforcement in the base slab. Pandrol has tested the new maximum height adjustment requirement very thoroughly against the relevant European CEN requirement, running 3 million load cycles with a block configured so we could test adjacent assemblies at installation heights of 0mm and +70mm.

On slabs with inclined rail seats, as vertical adjustments are made, the lateral position of the gauge face of the rail changes too. In order to maintain close control of track gauge, vertical adjustments may mean that the components that determine lateral alignment need to be replaced unless, like the Pandrol baseplate, the position of the baseplate itself can simply be adjusted. For HS2 for example, a +70mm height adjustment on a 1:20 rail inclination results in a 7mm change in gauge. This is much greater than the 2.5mm change that results from a +50mm maximum height adjustment on a 1:40 track, such as in China.

Speed of construction and maintenance are important and the Pandrol Fastclip Baseplate system allows machines to be used to switch the clips between the parked and installed positions to allow for rail change and de-stressing. The rates at which the clips can be applied and extracted are exceptionally high and well known in the UK. Train-mounted optical track inspection systems that allow the positions and surety of non-threaded Fastclip systems to be verified are readily available, and can operate at relatively high speeds – typically up to 160km/hr. As well as speed, these maintenance and inspection systems also help to keep workers off track and increase safety.

The global stiffness of the track controls several aspects of the behaviour of the vehicle-track system, but most track fastenings used on high speed lines incorporate at least one baseplate or steel plate, so that in principle at least two resilient layers can be introduced – one below and one above the plate. Even for a predetermined and specified global stiffness of the whole fastening, the selection of the stiffness of these two individual elements can affect overall dynamic performance.

This in turn may influence the level of wayside airborne noise, as well as the mechanical behaviour of the system in response to the loads applied to it – rail roll, dynamic gauge widening, and so on. This is a complex area where Pandrol has great understanding. But to confirm that its designs provide the best possible mitigation of airborne noise within the given constraints, Pandrol is working closely with the Institution of Sound and Vibration Research (ISVR) in Southampton to test different detailed design options.

ROBOTIC FUTURE

The combination of universal slabs with universal fastenings is an attractive proposition – but is not new. However, what is new and innovative is the way that Pandrol proposes to fit its baseplates to the slabs. Robots will be used to pick baseplates and place them in the exact positions and orientations required – transferring the expertise that the company has built up from its use in its clip manufacturing production lines.



The combinations of baseplate positions on a given slab can be selected at the touch of a button. Scanning assists and confirms the baseplate positioning and the configuration of each slab – and which end is which! This is then coded into an RFID tag that is affixed to the slab before it leaves the factory, so that the curve or transition where it is destined to be installed can be recalled at any time.

Robotic installation of baseplates is greatly facilitated by the fact that the Pandrol baseplate can be largely pre-assembled before it is installed on the slab in the factory. That's an advantage too when it comes to the second area where adjustment is essential. This is to maintain the track over its operating life.

A damaged baseplate could be replaced as a self-contained unit. There is no need to dismantle the fastening on track and no need to then know how to correctly reassemble it.

Lateral adjustments are particularly advantageous. The baseplate just needs to be loosened off, moved to the correct position and retightened. No additional replacement parts are required and there is no need to disassemble the fastening.

Vertical adjustments too are simple. The baseplates are loosened off, any additional shims required are slid into place and the baseplate is retightened. The height adjustment shims themselves are a very simple planar design, easily manufactured

to whatever precise thicknesses are required. There is no danger associated with assembling shims of different thicknesses in the wrong order.

This robotic process increases the reliability and quality of the installation on which the ultimate quality of the track alignment depends. It also increases the rates of production and reduces the risks of delays or interruptions. Pandrol's baseplates and robotic assembly are a great example of our future thinking approach which meets the demands and challenges of high speed rail.

66

Pandrol's baseplate can be infinitely adjusted over its +/-12mm lateral range.”

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CASE STUDY

PANDROL DELIVERS RAPID SOLUTION FOR HIGH SPEED LINE



Madrid–A Coruña, Spain

CUSTOMER: Azvi

DATE: 2020

SECTOR: High Speed

TRACK LENGTH: Up to 350km/h

Spain has the second largest high speed rail network in the world after China. The Madrid–Galicia high speed rail line connects the city of Madrid with the region of Galicia including A Coruña, a port city in the northwest. The line also provides a link between the Atlantic Axis high speed rail line and the rest of the Spanish AVE high speed network. Designed for trains running at speeds up to 350 kilometres per hour, the Madrid–Galicia high speed rail line has cut down journeys for locals dramatically.

The journey from Madrid to the historic north-western area of Galicia used to take five hours by car. Now, with the high speed rail line, the journey takes just two hours and 15 minutes.



CUSTOMER CHALLENGE

In 2020, our customer, Azvi, required a ballastless fastening solution to be installed on a long viaduct on the Madrid–Galicia high speed rail line. This was an added challenge due to the viaduct needing to support train speeds of up to 350 kilometres per hour.

With speed the name of the game, rapid execution was also a key requirement for the implementation of this project. Azvi needed a solution that could be installed in a very short time so as not to delay the project timeline, and with a high regulation capacity.

PANDROL SOLUTION

The fastening solution used for this project was the Pandrol Fastclip baseplate system, chosen for its easy installation, high speed references and high safety standards. Because the system is available in low toe load or zero longitudinal restraint configurations, it is ideally suited for use on bridge and viaduct applications.

Pandrol worked with sleeper manufacturing association AFTRAV to design and install five kilometres of pre-assembled slab track. The slabs were supplied as captive pre-assembled units ensuring accuracy and allowing fast and easy vertical (+70mm) and lateral (+/-12mm) adjustment per rail seat.

Simple to adjust, with strong anchorages using the GS dowel and the capability for tuning the stiffness if needed, the Fastclip baseplate was the perfect application for this project.

The Fastclip design is optimised for automated installation. Pandrol's CD100 clipping machine was used to ensure safe, quick and easy clipping. Compact and lightweight, the CD100 is suitable for use by a single operator and can be easily carried onto site.



THE RESULTS

Where rapid installation is paramount, Pandrol was able to deliver results to ensure that the project could be completed swiftly and efficiently. Designed to be easily adjustable to meet the demanding requirements of high speed rail, the Fastclip Baseplate is perfectly equipped to handle any seismic changes in this pressured environment.

Pandrol provided technical support and expertise to both AFTRAV and Azvi throughout design installation and completion to enable a smooth and safe delivery and installation process.





PANDROL



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