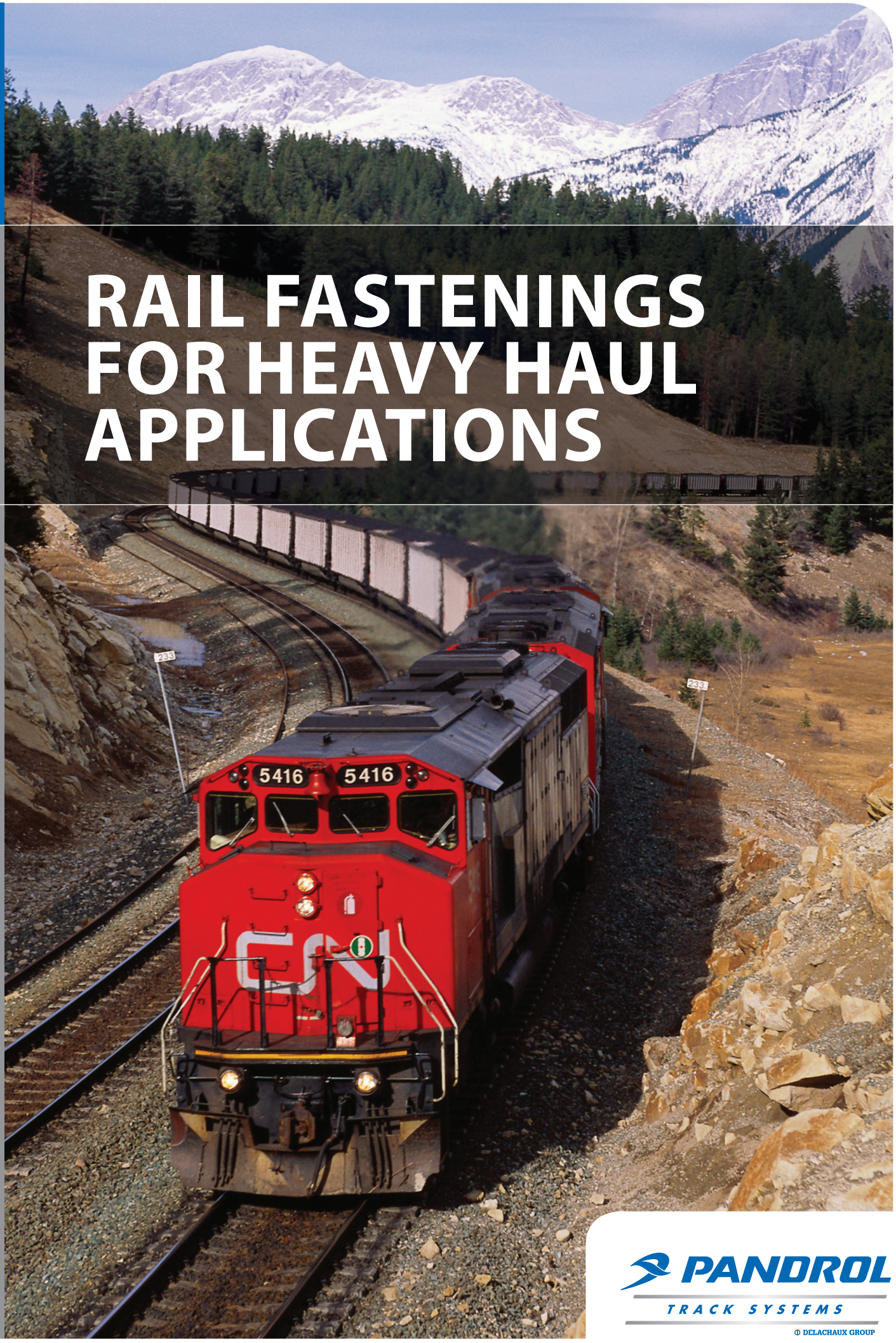
PERFORMANCE

TECHNICAL

FEATURES

ASSEMBLY

RAIL FASTENINGS FOR HEAVY HAUL APPLICATIONS



PANDROL

TRACK SYSTEMS

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PANDROL WORLDWIDE HEAVY HAUL INSTALLATIONS

Pandrol Worldwide Axle Loads >25 Tonnes Installations

Country	Rail Authority	Line	Fastening Type	Toe Load (kgf)	Axle Load (tonnes)	Min Curve radius (m)	Length	Years' Experience or Year Installed
Australia	ARTC	Hunter Valley Coal Lines	FASTCLIP	min 1000	up to 30	N/A	>1000km	>5 years
Australia	Aurizon (Formerly QR National)	Central Queensland Coal Network	FASTCLIP	min 1000	26	N/A	>2600km	>5 Years
Australia	ARTC	Hunter Valley Coal Lines	e2000	1250	up to 30	300	>1000km	>20 Years
Australia	BHP Iron Ore	Pilbara Mainline Network (Iron Ore)	e2000	1250	37	400	>1600km	>20 Years
Australia	Rio Tinto	Pilbara Iron Network (Iron Ore - includes Hamersley Iron & Robe River Mining)	e2000	1250	37.5 - 40	400	>1600km	>20 Years
Australia	Fortescue Metals Group	Pilbara Mainline Network (Iron Ore)	e2000	1250	40	1000	>650km	>4 Years
Australia	Aurizon (formerly QR National	Central Queensland Coal Network	e2000/FIST	min 1000	26	200	>2600km	>20 Years
Brazil	VALE Carajas Railroad	Iron Ore	DE + e-Clip	1000	37 MT	860	>890km	>20 Years
Brazil	VALE Vitoria-Minas Railroad	Iron Ore	DE	1000	30 MT	300	>1200km double track	>30 Years
Brazil	North-South	Railroad	e-Clip	1000	30 MT	400	>1800km	>10 Years
Brazil	MRS	Mixed Freight	e-Clip	1000	32 MT	300	>1600km	>30 Years
Canada	Canadian National	Mixed Freight	e2000	1250	33	220	>2100km	>20 Years
Canada	Canadian Pacific	Mixed Freight	e2000	1250	33	150	>2100km	>20 Years
Estonia	Estonian Railways	Mixed Freight	FASTCLIP	1000	32	2000	>250km	>10 years
Georgia	Georgian Railways	Mixed Passenger / Freight	FASTCLIP	1000	25	N/A	>150km	>10 years
Lithuania	Mainline Corridors	Mixed Passenger / Freight	FASTCLIP	1000	25	500	>225km	>10 Years
Mexico	Ferromex / TFM	Freight	e2000	1000	25	N/A	>820km	>10 Years
Norway	Norwegian State Railways	Narvik-RiksgransenOreLine	e2000	1250	30	400	>50km	>5 Years
Saudi Arabia	North-South	Freight	FASTCLIP	1250	32.4	N/A	>2000km	Since 2011
South Africa	Spoornet	Shishden / Saldanha Iron Ore Line	e2000/FIST	1250	30	400	>1000km	>30 Years
South Africa	Spoornet	Richards Bay Coal Line	e2000/FIST	1250	26	400	>700km	>30 Years
Sweden	Trafikverket	Malmbanan Ore Line	FASTCLIP	1250	30	300	>65km	Since 2008
Sweden	Trafikverket	Mixed Passenger Freight	FASTCLIP	1000	25	300 - 400	>1000km	>5 Years – 2008
Sweden	Trafikverket	Malmbanan Ore Line	e2000/ e1817	1250	30	300	>300km	>20 Years
Sweden	Trafikverket	Mixed Passenger / Freight	e1800/ e2000	900/1250	25	300 - 400	>8000km	>30 Years
USA	Union Pacific	Heavy Haul Freight	e2000/ SAFELOK/ SAFELOK III	1250	36	175	>10,000km	>20 Years e-Clip >10 Years SAFELOK III
USA	CSX	Mixed Freight	FASTCLIP	1250	36	220	>1300km	>8 Years
USA	Florida East Coast	Mixed Freight	FASTCLIP	1250	30	N/A	>15km	>8 Years
USA	CSX	Mixed Freight	e2000	1250	36	220	>1500km	>20 Years
USA	Norfolk Southern	Mixed Freight	e2000	1250	30	290	>1500km	>20 Years
USA	Florida East Coast	Mixed Freight	e2000	1250	30	N/A	>35km	>20 Years
USA	BurlingtonNorthern	Mixed Freight	e2000/ SAFELOK	1250	35	175	>15,000km	>20 Years

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RAIL FASTENINGS FOR HEAVY HAUL TRACKS

Pandrol rail fastenings have been used on all of the major heavy haul railways in the world with a track record covering more than four decades and extending across all continents.

Pandrol Rail Fastenings are in service on axle loads up to 40 tonnes and performing in climates ranging from the exceptional dry arid deserts of North West Australia and the Middle East, through the humid tropics of Africa to the extreme cold of Canada and Scandinavia.

All Pandrol heavy haul assemblies incorporate threadless technology delivering high quality track and very low maintenance ideally suiting heavy haul rail operations.

Testimony to Pandrol's threadless technology is one of the great dedicated iron ore railways of the world at Hamersley Iron, which operates iron ore trains of up to 35,000 tonnes between Paraburdoo and Dampier in Northwest Australia, and transports 90 million gross tonnes per year, and which first operated on timber sleepers with Pandrol clips in 1978. The performance of the Pandrol clips was such that when the original timber sleepers were replaced with concrete sleepers in 1986, the original fastenings were recycled and reused on the new concrete sleepers. All track extensions have been with Pandrol clips and there have been no maintenance or operational problems to date.

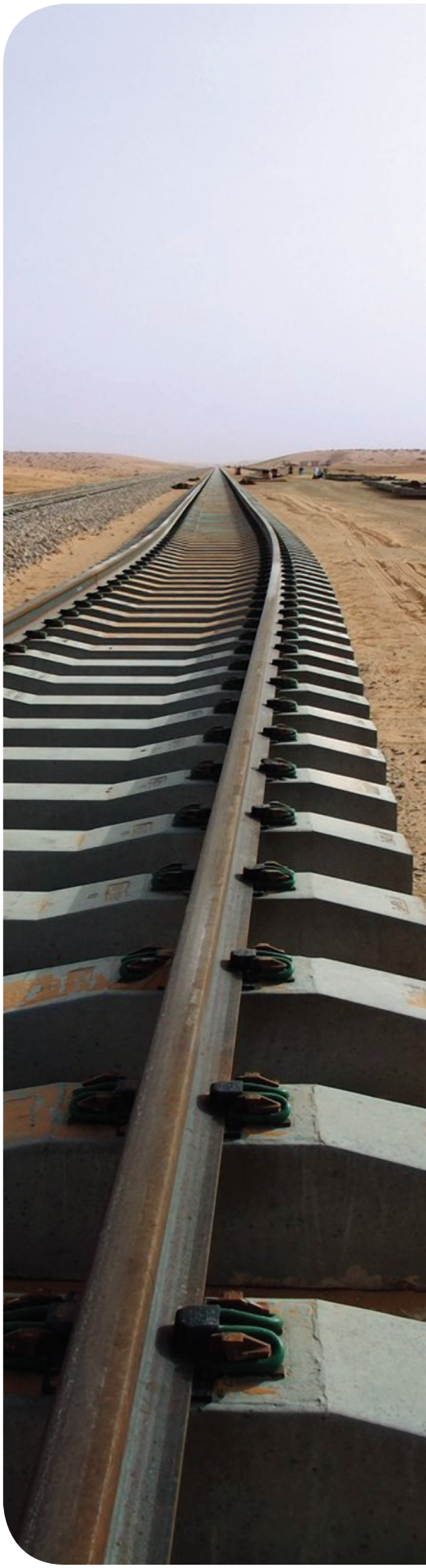
Many heavy haul operators in North America have used Pandrol fastenings to the exclusion of all else, including CN, CP, CSX and Florida East Coast Railway.

VALE (Brazil) and Spoornet (South Africa) also operate heavy haul tracks, exclusively with Pandrol clips.

In recent years, Pandrol Fastclip has been used increasingly by heavy haul operators, with unprecedented use of high output mechanisation for installation and maintenance which delivers lower installation costs for contractors and repeated efficiencies for stressing operations, re-railing and rail maintenance activity throughout the life of the fastening system.

Pandrol Fastclip was first installed in heavy haul track in the USA in 1993, and since then test sites and commercial installations have expanded rapidly.

Performance in the most arduous conditions has been impressive. Components removed for inspection at one site after 880 million gross tonnes showed insignificant wear to the insulator components.



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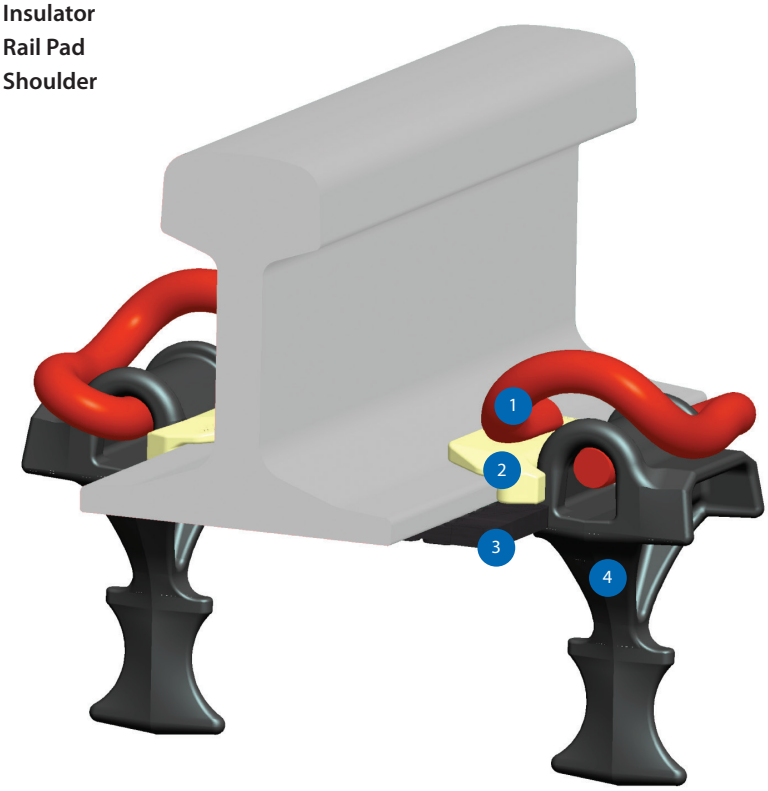
PANDROL BRAND e-CLIP

1 Clip
2 Insulator
3 Rail Pad
4 Shoulder



PRODUCT FEATURES

- Few, simple components
- Well Proven globally
- System can be mechanised
- Very long life
- High safety level and security
- Proven on all types of ballasted track
- Used in turnouts and crossings
- Can be supplied in anti-vandal form
- Virtually maintenance free
- No threads to strip or corrode

Although the Pandrol e-Clip is increasingly being superseded by the pre-assembled Pandrol Fastclip, these fastenings are still widely used in many countries. They remain popular because they are simple, reliable, well-proven systems, suitable for every type of track and traffic condition.

The Pandrol e-clip system is typically manufactured from 20mm bar, generates up to 1,250kgf nominal toe load and has been widely adopted for heavy haul axles up to 40 tonnes.

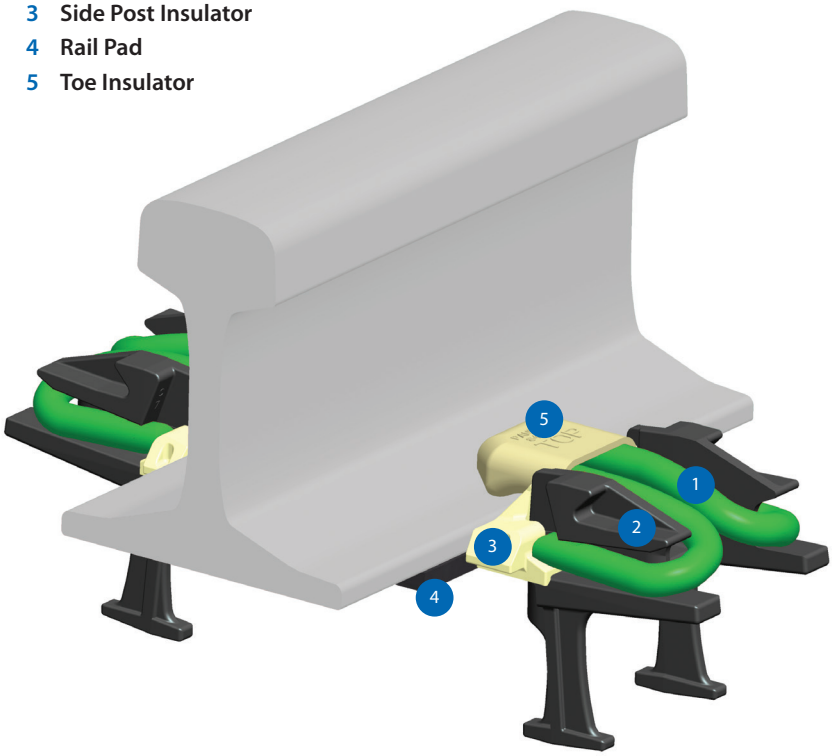
Pandrol will advise on which pad and insulator materials to use, subject to the environmental and operating conditions. As a general rule, the use of HDPE, TPE or PU is preferred for high axle loads.

PANDROL e-PLUS

Pandrol e-Plus utilises the technology of the two piece insulator concept developed for Fastclip. It also has the unique feature of a toe insulator which 'rolls' on the rail base as the rail moves laterally. It is ideally suited to locations where the very high lateral forces shorten the life of conventional insulators. By splitting the insulator into two separate elements it allows the use of different materials for the two components, which is demonstrating greater component life for this vital part of the concrete sleeper assembly.

PANDROL FASTCLIP

1 Clip
2 Shoulder
3 Side Post Insulator
4 Rail Pad
5 Toe Insulator



PRODUCT FEATURES

- Few, simple components
- Well Proven globally
- Pre-assembled
- System is designed for mechanised installation
- Very long life
- High safety level and security
- Proven on all types of ballasted track
- Used in turnouts and crossings
- Can be supplied in anti-vandal form
- Virtually maintenance free
- No threads to strip or corrode
- High Output Mechanisation on new build and output
- Faster installation than any other system – by far!

The Pandrol Fastclip is a resilient, threadless rail fastening system with the unique Pandrol switch on-switch off mechanism that enables fast, efficient track installation and reduced maintenance costs.

Pandrol Fastclip assemblies for heavy haul applications are available in two variants: FC1500 and FC1600.

Fastclip FC1500 is made from 15mm diameter bar and has been used on railways in Estonia, Georgia, Lithuania and Uzbekistan for general freight applications with axle loads of up to 32 tonnes with a 1000kgf toe load.

Pandrol FC1600 has a 1250kgf toe load and is made from 16mm diameter bar. FC1600 is used with a heavy duty shoulder and is designed for use on heavy haul railways up to 40 tonnes.

LEARN MORE ABOUT PANDROL TECHNOLOGY.

LEARN MORE >

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INSTALLATION AND EXTRACTION OF PANDROL CLIPS

- **Installation automatically generates the correct clamping force**
- **No torque wrenches or other setting up procedures are required**
- **Pandrol clips can be installed with simple hand tools or mechanised equipment**

e-CLIP

HAND TOOLS

MECHANISED

PANDROL FASTCLIP

HAND TOOLS

MECHANISED

PANDROL FASTCLIP

The latest mechanised clipping equipment for Pandrol Fastclip from Rosenqvist Rail AB is the CD500 machine which is capable of installing Fastclip at the rate of 70 sleepers per minute. There is also a wide range of machinery available from other machine makers which provides flexibility on performance against budget. Further Information can be obtained from Pandrol Ltd.

APPLICATION DATA

(Standard Products – special variants* may be available for other applications)

Application	Concrete sleepers in ballast				
Clip Type	FC1500	FC1600	ePlus	ePlus	e2000
Pad Type	Rubber	PU/HDPE	Rubber	PU/HDPE	PU/HDPE
EN13481 Track Category	Category E				
Maximum Axle Load	32.5 tonnes	40 tonnes	32.5 tonnes	40 tonnes	40 tonnes
Minimum Curve Radius	400m**	150m	400m**	150m	150m

* For special applications consult Pandrol
** May be applicable for curve radius <400m – Consult Pandrol for details.

TYPICAL PERFORMANCE DATA

Typical Performance	Clip Type	Value	Test Method	Remarks
Assembly Static Stiffness	FC1500	>60kN/mm	EN13146-9:2009 (7.1 Cat E)	Rubber Pad
	FC1600	>150kN/mm	EN13146-9:2009 (7.1 Cat E)	PU/HDPE Pad
	ePlus	>60kN/mm	EN13146-9:2009 (7.1 Cat E)	Rubber Pad
	ePlus	>150kN/mm	EN13146-9:2009 (7.1 Cat E)	PU/HDPE Pad
	e2000	>150kN/mm	EN13146-9:2009 (7.1 Cat E)	PU/HDPE Pad
Assembly Dynamic Stiffness	FC1500	>100kN/mm	EN13146-9:2009 (7.2 Cat E)	Rubber Pad
	FC1600	>300kN/mm	EN13146-9:2009 (7.2 Cat E)	PU/HDPE Pad
	ePlus	>100kN/mm	EN13146-9:2009 (7.2 Cat E)	Rubber Pad
	ePlus	>300kN/mm	EN13146-9:2009 (7.2 Cat E)	PU/HDPE Pad
	e2000	>300kN/mm	EN13146-9:2009 (7.2 Cat E)	PU/HDPE Pad
Clamping Force	FC1500	>16kN	EN13146-7:2012	Nominal toe load 10kN
	FC1600	>21kN	EN13146-7:2012	Nominal toe load 12.5kN
	ePlus	>21kN	EN13146-7:2012	Nominal toe load 12.5kN
	e2000	>21kN	EN13146-7:2012	Nominal toe load 12.5kN
Impact Attenuation	FC1500	>30%	EN13146-3:2012	Rubber Pad
	FC1600	N/A	N/A	PU/HDPE Pad
	ePlus	>30%	EN13146-3:2012	Rubber Pad
	ePlus	N/A	N/A	PU/HDPE Pad
	e2000	N/A	N/A	PU/HDPE Pad
Creep Resistance	All	>9kN	EN13146-1:2012	Onset of slip
Electrical Insulation	All	>5kΩ	EN13146-5:2012	Rail to rail, wet test
Typical Lateral Adjustment	All	N/A	N/A	For Lateral Adjustment or Gauge Widening please consult Pandrol
Typical Vertical Adjustment	All	N/A	N/A	Not required for ballasted track

For performance against other testing criteria such as American AREMA Chapter 30, Australian AS1085-19 and Japanese RTRI please consult Pandrol.

RESEARCH AND DEVELOPMENT

Pandrol is committed to develop and manufacture new and better track fastening components to meet the increasingly stringent demands for heavier axle loads and larger train weights.

Pandrol maintains close collaboration with railway engineers throughout the world and monitors track performance on-site using both conventional and unique measuring equipment. Data acquisition and analysis, using the most modern equipment, which provides the basis for continual research into the dynamic behaviour of the whole track structure, and the influence of each component upon that behaviour. Information gathered is used to both develop and improve existing components and to develop new ones.

It is our policy to work in close cooperation with railways to design each rail fastening assembly to suit their particular requirements, taking into account local needs and experience.

As a company, Pandrol has been in the business of resilient rail fastenings since 1937 and celebrated 75 years in 2012. The Pandrol range of rail fastenings is already the most widely used elastic fastening system and continues to be introduced to new markets.

NOTE:
Pandrol is an innovator and designer of bespoke rail fastenings. The data shown above is indicative of typical performance, but is naturally dependant on external factors. Should you have different requirements, please contact us to discuss tailoring products to suit local operating conditions. The technical information given in this brochure was correct at the time of printing, however the company undertakes a continuing programme of research and development and improvements may since have been introduced.

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