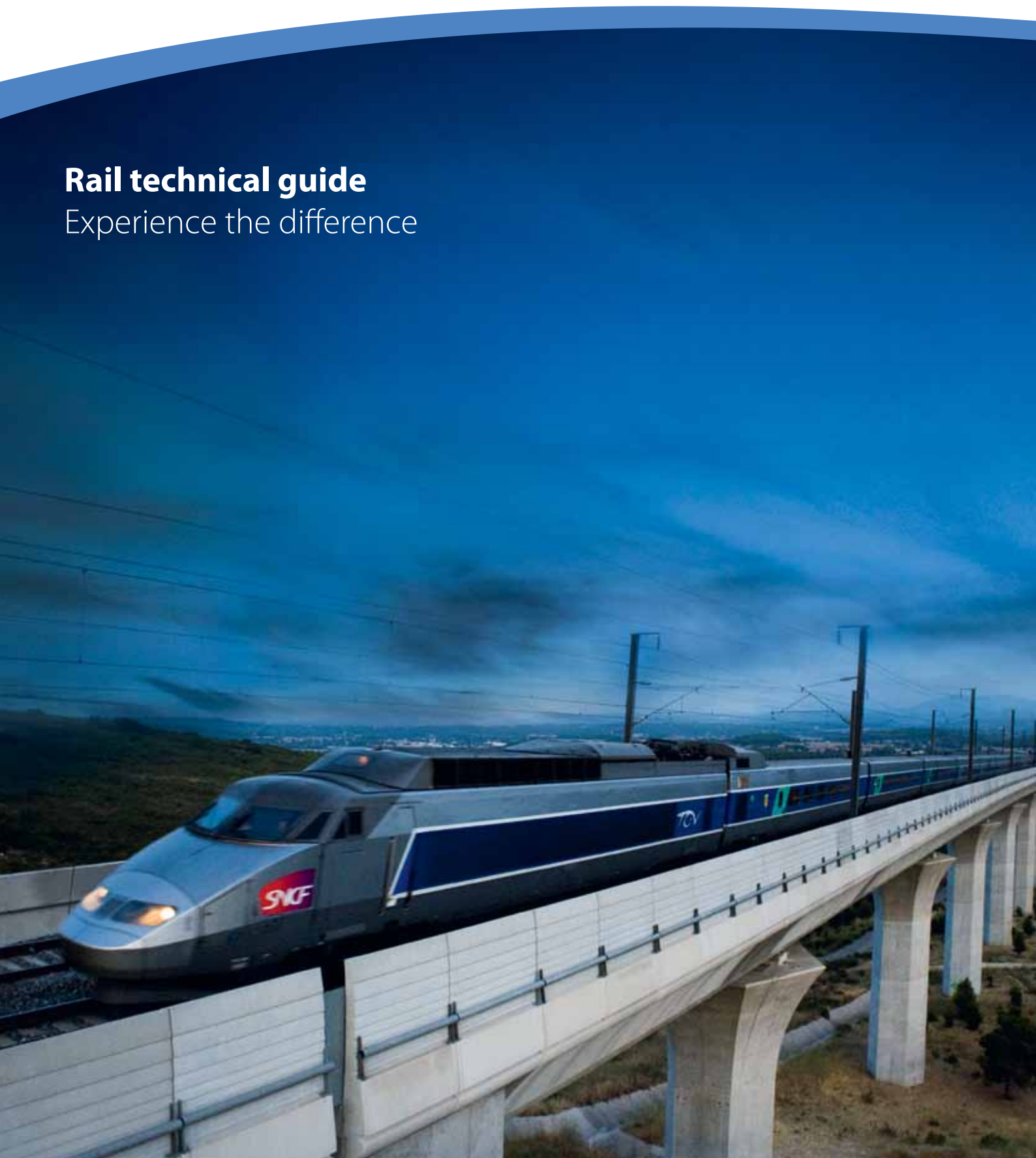


TATA STEEL



Rail technical guide
Experience the difference



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INTRODUCING TATA STEEL

As a leading global steelmaker, Tata Steel combines metallurgical expertise with rail-industry knowledge and a collaborative ethos, enabling it to manufacture finished steel products that directly address customer needs.

Tata Steel – setting the global standard in steelmaking

Tata Steel, formerly known as Corus, is one of Europe's largest steel producers. We serve many different and demanding markets worldwide, including rail, aerospace, automotive, construction, energy and power, and packaging. Our primary steelmaking operations in the UK and the Netherlands are supported by a global sales and distribution network.

Innovation and continuous improvement are at the heart of our performance culture. We aim to create value by offering a sustainable and value-added steel product range supported by unrivalled customer service. By working in partnership with you, we find the best solutions to meet your needs and help your business to perform.

Our European operations are a subsidiary of Tata Steel Group, one of the world's top ten steel producers. With a combined presence in nearly 50 countries, the Tata Steel Group including the Europe operations, Tata Steel Thailand and NatSteel Asia, has approximately 80,000 employees across five continents and a crude steel production capacity of over 28 million tonnes.

Supporting rail industry growth and development

The company's drive for innovation and market leadership is clearly manifested in its rail manufacturing operations. Building on 140 years of rail production expertise, the company today works closely with rail customers to understand the demands of the sector and develop products that directly address those needs. That means Tata Steel is playing a central role in helping the rail industry rise to the challenges of higher traffic volumes, heavier axle loads and faster train speeds.

As a diversified steel manufacturer, Tata Steel not only supplies specially designed, high-performance rail products, but also a wealth of structural steel components to support all rail sector construction and engineering projects.

INVESTMENT AND INNOVATION

Continuous investment in plant, technology, research and development, combined with our unrivalled metallurgical knowledge and track design expertise, ensure that Tata Steel delivers the high-performance rail demanded by today's rail operators.

Tata Steel has rail manufacturing expertise stretching back 140 years. Today the company manufactures the highest quality steel rails for some of the most arduous service conditions in the rail sector.

Since 2000, we have invested more than £150m (€200m) in our advanced rail manufacturing facilities at Scunthorpe in the UK and Hayange in France – ensuring that we remain at the forefront of rail innovation, performance and value, always working in close partnership with our customers.

Both of our mills feature state-of-the-art equipment including servo-stands allowing high dimensional accuracy rotary stampers to uniquely identify each rail. This allows complete traceability, from steelmaking to the finished product. Computer-controlled cambering operations installed on precision-engineered cooling banks, and dual plate roller straighteners ensure excellent straightness and flatness while maintaining low residual stress within the rail.

Scunthorpe invests in steelmaking, rolling and finishing

Investments in steelmaking and casting at Scunthorpe enable us to produce the quality and quantity of bloom feedstock required for both of our rail rolling mills.

At Scunthorpe, a major enhancement to the existing rolling mill saw the introduction of a new furnace and a close-coupled seven-stand finishing mill train – a world first for rail rolling.

A new Rail Service Centre has been constructed to carry out essential rail finishing operations using the world's best available technology, including a full range of non-destructive testing (NDT) systems to ensure exceptional

dimensional accuracy and rails totally free of surface or metallurgical defects. The service centre enables us to produce rails up to 120m long with precisely controlled properties that meet our customers' stringent specifications. A state-of-the-art welding plant means we can produce rails up to 216m long for delivery and installation in one piece – meeting the industry's need for longer rails and simplified supply chains.

Hayange invests in long length rail capability

Investments at Hayange in France have enabled this dedicated rail manufacturing facility to produce 108m-long rails. Advanced heat treatment machinery is able to produce our ultra wear-resistant micro head hardened (MHH) rail, designed for heavy haul and high-duty track environments, as well as standard heat treated grades according to the European or American standards. Rails with hardness values above 400HB can now be manufactured here, while the unique patented heat treatment creates rails with exceptionally low residual stress levels.

The technique for universal rolling of rails was invented at Hayange to deliver the precise dimensional consistency and accuracy required for high-speed tracks, as well as complex-shaped grooved rails for urban networks. The technique has been adopted and further developed at Scunthorpe. It has proved so successful that, in April 2007, SNCF broke the world train speed record on the new French TGV Est line constructed using Tata Steel universal-rolled rails.

Process innovations and product development initiatives at Tata Steel are focused unwaveringly on delivering the high-performance rails required to support advances in train technology, as well as meeting the longer in-service product life and reduced maintenance costs demanded by rail network operators.

STEELMAKING AND ROLLING

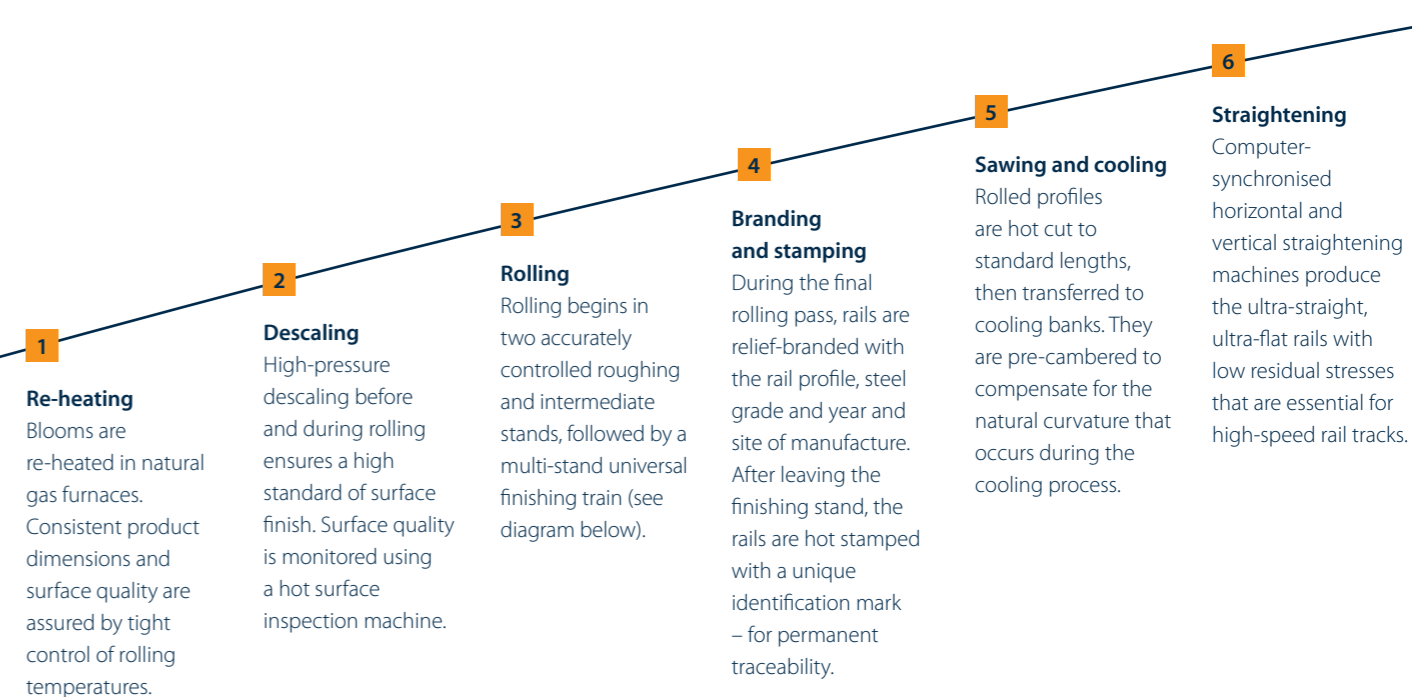
Steelmaking

The Scunthorpe integrated steelmaking plant produces feedstock for a diverse range of steel products. The precision-controlled steelmaking process delivers only the highest-grade, consistent-quality steel blooms for our rail rolling mills.



Rolling

The Tata Steel rolling mills at Scunthorpe and Hayange use the latest process technology, computer modelling, computer-controlled heating and cooling, and novel roll-pass design to produce exceptional quality rails.



Universal rolling

Universal rolling of rails was pioneered by Tata Steel's Hayange works. Four rollers are positioned on all four sides of the steel feedstock, rather than the conventional pair of rollers in a two-high rolling stand – delivering exceptional dimensional accuracy and strengthening of the rail head.



TESTING, INSPECTION AND FINISHING

The advanced testing and finishing systems that complete the Tata Steel rail manufacturing process ensure that all rail products meet the high standards required for all rail applications – from high-speed and heavy-haul networks to urban and industrial railways.

Rigorous tests for complete quality assurance

An array of technically advanced testing and inspection equipment ensures that every rail meets customer specifications and is free from any internal or surface imperfections that could impede performance or reduce service life.

Eddy current testing is used to detect any surface imperfections that exceed specification limits. Rails also require a uniform internal metallurgical structure to ensure strong performance, and any irregularities that could adversely affect the rail's in-service life are detected using in-line ultrasonic testing. Any defects identified are checked manually using portable ultrasonic equipment.

A cold profile gauge, installed in the non-destructive testing (NDT) lines, continuously measures rail dimensions. Laser beams are used for optical sectioning of the rail, and sophisticated software analyses pictures taken of all rail dimensions by an array of cameras so that dimensions can be carefully controlled.

To meet the extreme straightness requirements of high-speed tracks we use laser technology to measure rail surface and side-of-head flatness and straightness, ensuring rails meet all customer and statutory specifications.

Finished to individual customer specifications

Rails are finished by cutting to length for each customer order. Sawing and drilling are carried out by high-speed combined machines that give the greatest accuracy. Other finishing processes include:

- **rail coating for corrosion protection**
Rail destined for corrosive or harsh environments, such as coastal routes, tunnels, level crossings or marine environments can be protected using corrosion-resistant rail coatings to deliver an extended service life.
- **extensive acceptance testing**
Acceptance tests can be carried out to individual customer specifications, in the presence of the customer if requested. These tests can include hardness, tensile, decarburisation, segregation and steel cleanliness assessments.
- **seamless rail welding**
Tata Steel leads the market in rail welding expertise, having developed and patented the 'invisible' narrow heat affected zone weld. In the UK, the Rail Service Centre's integral welding plant enables rail lengths of up to 216m to be produced as part of the rail finishing process. The flash butt welding method used creates a strong weld made purely of the parent material, providing consistent steel properties along the entire 216m length.

Reliable, on-time delivery – worldwide

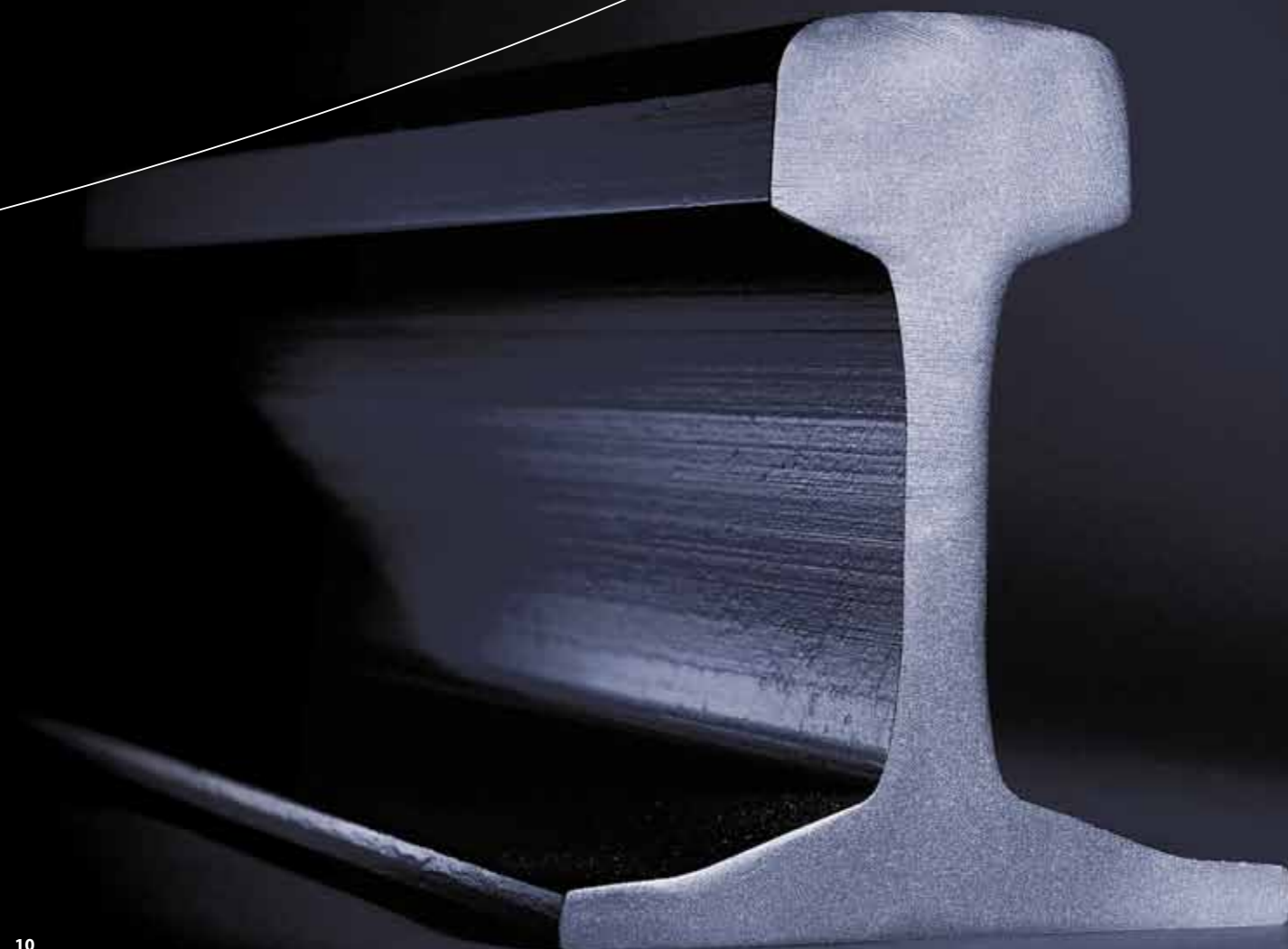
Tata Steel plants are strategically located for fast, efficient delivery of rail products worldwide, using road, rail, river or marine transport.

Welded rails up to 216m long are despatched from Scunthorpe on specially designed trains able to handle and directly offload these extended rail lengths.

Our proven and efficient despatch processes ensure that delivery costs are minimised. Complete supply chain control enables us to make just-in-time deliveries that facilitate efficient and timely track replacement and minimise disruption to rail users.

PRODUCT RANGE AND APPLICATIONS

The wide spectrum of track and traffic conditions found in the modern railway environment is matched by Tata Steel's comprehensive range of steel rail products – fulfilling every demand of the international railway industry.



High-speed railways

Long, straight, flat, fatigue-resistant rail for record-breaking performance.

High-speed railways offer benefits in safety, environmental performance and passenger comfort over road and air transport. Tracks are usually dedicated to high-speed traffic, comprising predominantly tangent and large radius curves. The challenge for rail manufacturers is to provide consistency in long, straight and flat rails, combined with dimensional accuracy and steel integrity to deliver trouble-free, decades-long service life.

The principal causes of degradation in high-speed rail are:

- Vertical and side wear
- Rolling contact fatigue (RCF)
- Discrete defects such as squats or belgrospies

Heavy-duty railways

Hardened rails for unrivalled wear resistance in extreme conditions.

High-strength rails are required for tracks subject to very high loads and extreme wear stresses. These tracks include those used by trains with very high axle loads (25-35 tonnes) and high annual gross tonnage. Many heavy-haul rail operators have recognised the need to introduce high-performance rail to deliver longer life and reduce lifetime costs. Speeds on these tracks are relatively low and so wear resistance determines the frequency of rail replacement.

The principal causes of rail degradation are:

- Side and vertical wear
- Plastic deformation
- Rolling contact fatigue (RCF)
- Discrete defects such as squats

Our technical team is available to provide advice and support, helping you to optimise your rail selections. Rail products and grades can be matched precisely to track conditions, track types, environmental conditions and a host of other variables to ensure that every rail we deliver provides optimum performance throughout its service life.

The Tata Steel products suitable for high-speed railways are:

| Tata Steel product grade | Key attributes | Customer benefits |
|--|---|---|
| R260 (and other standard grades) | Class A straightness. Class X dimensions. | Cost-effective standard rail with typical service life of approximately 30 years. |
| Heat treated grades R350HT/ R350LHT | Increased resistance to wear and RCF compared to R260. | Increased life in track with tighter curves. |
| HPrail | Increased resistance to wear and RCF. | Wear and RCF resistance where this impacts rail life. Reduced grinding frequency. |
| Bainitic rail B320/B360 | Highest resistance to RCF. | Controls RCF with reduced grinding frequency. Used for switches and crossings and other high RCF areas. |
| Sogenox | Achieves perfect electrical contact between rail and train wheel in areas of low traffic. | Maintains robust signalling and prevents premature rusting of the rail head. |

The Tata Steel products suitable for heavy-duty railways are:

| Tata Steel product grade | Key attributes | Customer benefits |
|---|--|---|
| AREMA 325 HB intermediate strength | Good wear resistance. | Proven, predictable performance – widely used on heavy-haul tracks. |
| HPrail | Improved wear resistance and RCF resistance compared to AREMA 325HB. | Extended rail life in areas where RCF or wear are the main causes of degradation. |
| MHH | Highest resistance to wear and plastic deformation, with very low residual stress. | MHH provides the most wear-resistant rail for the most arduous conditions. |



Mixed traffic railways

Full range of rail grades each tailored for specific track conditions.

Conventional speed mixed traffic railways have the difficult task of optimising track performance for the mix of relatively high-speed passenger trains and slower, high axle weight freight services. Nevertheless, infrastructure managers need to reduce the life cycle costs of track maintenance by extending rail component life.

The key causes of rail degradation in mixed-use railways are:

- Side and vertical wear – rate increases with decreasing track radius
- Rolling contact fatigue (RCF)
- Discrete defects such as squats
- Plastic deformation of low rail

The Tata Steel products suitable for mixed-use railways are:

| Tata Steel product grade | Key attributes | Customer benefits |
|------------------------------------|---|---|
| R200 | Relatively soft grade promoting rapid wheel-rail profile conformity to reduce contact stresses. | May reduce susceptibility to discrete defects such as squats on tangent track. |
| R260 | Increased rail life compared to R200. | Used on tangent, large radius and low-tonnage track. |
| Heat treated R350HT/R350LHT | Increased resistance to wear and RCF compared to R260. | Increased life in track with tighter curves. |
| HPrail | Increased resistance to wear and RCF compared to R260. | Ideal for transitions and curves of less than 3,000m for: – wear and RCF resistance – control of low rail plastic deformation – reduced grinding frequency |
| MHH | Finest pearlitic microstructure with high resistance to wear and RCF. Very low residual stress. | Ideal for tight radius curves for: – wear and RCF resistance – control of low rail plastic deformation – reduced grinding frequency |
| Sogenox | Achieves perfect electrical contact between rail and train wheel in areas of low traffic. | Maintains robust signalling and prevents premature rusting of the rail head. |

Metro railways

Resilient rail grades to withstand high-frequency traffic and tight curves.

Although metro systems are characterised by lighter axle loads than their mainline counterparts, they generally comprise larger proportions of tighter radius curves, more frequent stations, a larger number of axle passes and greater traffic density. The combination of these track and traffic characteristics creates very complex and demanding stress conditions at the wheel-rail interface.

The key causes of rail degradation in metro railways are:

- Side and vertical wear – rate increases with decreasing track radius
- Corrugation
- Rolling contact fatigue (RCF)
- Plastic deformation of low rail

The Tata Steel products suitable for metro railways are:

| Tata Steel product grade | Key attributes | Customer benefits |
|--------------------------|--|---|
| R200 | Relatively soft grade promoting rapid wheel-rail profile conformity to reduce contact stresses. | Suited to tangent or shallow radius curve track experiencing little or no corrugation, low vertical wear but susceptible to discrete squat defects. |
| R260 | Increased rail life compared to R200. | Used on tangent, large radius and low-tonnage track. |
| HPrail | Increased resistance to wear and RCF compared to R260. | Ideal for transitions and curves of less than 3,000m for: – wear and RCF resistance – control of low rail plastic deformation – reduced grinding frequency |
| MHH | Finest pearlitic microstructure with high resistance to wear and RCF. Very low foot residual stress. | Transition and tight radius curves, generally <1,000m, where rail life is curtailed by wear and RCF. |

Tramway systems

Specialist rails for quiet, wear-resistant operation and easy maintenance.

Most modern tramway networks comprise both embedded and ballasted track in which the benefits of the much lower axle loads are more than eroded by very tight curve radii, as low as 15m, and steep gradients. Equally, the frequency of passenger service and the need to share parts of the infrastructure with other road users places unusually demanding conditions on the rail.

The key causes of degradation to grooved and flat-bottomed rails in tramway systems are:

- Side wear (in addition to gauge corner and side wear on tight radius curves, grooved rails also experience wear to the keeper section of the adjacent rail)
- Vertical wear – since side wear is weld restorable, rail life is determined by the magnitude of vertical wear
- Corrugation – influenced by a range of track system features



The Tata Steel products suitable for tramway systems are:

| Tata Steel product grade | Key attributes | Customer benefits |
|------------------------------------|--|--|
| Grooved rails: | | |
| R200 and R220G1 | Relatively soft grades with baseline level of wear resistance. | Traditionally used for tangent track or very shallow radius curve track experiencing little or no corrugation and low rates of vertical or side wear. |
| R260 | Standard grade with greater wear resistance than R200 and R220G1 with the added benefit of being weld restorable using the Tata Steel process. | Improved life cycle cost option (with weld restoration) for all track of <100m radius. Weld repairable for second or third life extension. |
| Weldable extra life rail | Microstructurally engineered steel giving higher resistance to wear than grades with higher levels of hardness. | Lowest life cycle cost option (with weld restoration) for all track of <100m radius. Increased wear resistance and weld repairability provides the most cost-effective solution for tight curves. Also suitable for all larger radius track. |
| Flat-bottom rail (Vignole): | | |
| R260 | Standard grade with a hardness level to give baseline wear resistance and rail life. | Generally suitable for all larger radii or tangent track. |
| HPrail | Increased resistance to wear and rolling contact fatigue. | Lower life cycle cost option for all track of <100m radius, but also suitable for larger radii track. |

Crane rail

Strong, hard-wearing special rail profiles.

Tata Steel supplies a range of special crane rail profiles, manufactured to DIN 536 part 1. Six sizes of rail are available in three different specifications to meet customer tensile strength requirements – with minimum strengths ranging from 690N/mm to 880N/mm.

The six crane rail sizes we supply are shown in the table:

The Tata Steel products suitable for cranes in all applications

| Rail | Kg/m | K | B3 | B1 | H1 | H2 | F3 | R1 | R6 |
|---------------|-------|-------|------|-------|-------|------|-------|----|------|
| A65 | 43.1 | 65 | 38 | 175 | 75 | 34 | 10 | 6 | 5 |
| A75 | 56.2 | 75 | 45 | 200 | 85 | 39.5 | 11 | 8 | 6 |
| A100 | 74.3 | 100 | 60 | 200 | 95 | 45.5 | 12 | 10 | 6 |
| A120 | 100.0 | 120 | 72 | 220 | 105 | 55.5 | 14 | 10 | 6 |
| A150 | 150.3 | 150 | 80 | 220 | 150 | 64.5 | 14 | 10 | 6 |
| MRS87A | 86.8 | 101.6 | 34.9 | 152.4 | 152.4 | 50.8 | 31.75 | 8 | 12.7 |

All dimension are in mm. Quotations for other sizes and specifications available on request. Crane rails are normally supplied in 12m cold sawn lengths, with a cutting tolerance of + 100 / - 0 mm. Other lengths are available.

Diagram for A65, A75, A100, A120, A150

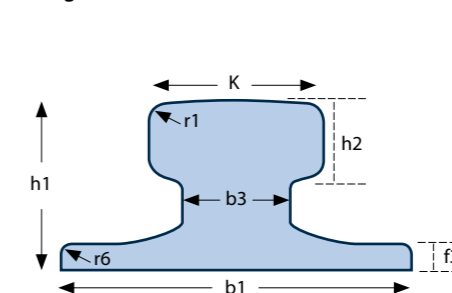
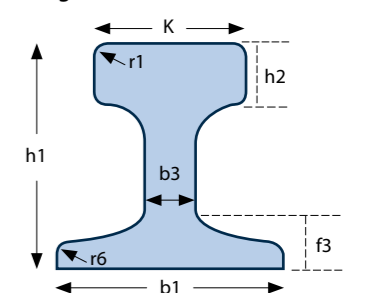


Diagram for MRS87A



MUCH MORE THAN RAIL

SilentTrack®

Reduces overall train pass-by noise by 3-7 dB (A).

Tata Steel has developed SilentTrack® to help rail operators save costs on lines that pass through urban areas where noise levels must be minimised. SilentTrack® uses sound absorbers on the rail web and upper part of the foot to reduce noise – eliminating the need to construct expensive noise-abatement walls alongside the tracks.

Railcote®

Corrosion-resistant rail coating for harsh environments.

For harsh environments where tracks could be subject to heavy wear or corrosion, Tata Steel can supply rails treated with Railcote – a high-purity zinc coating ideal for tracks in tunnels, at level crossings and in marine environments.

As a major steel manufacturer, Tata Steel produces a host of steel products for construction and engineering applications in the rail industry.

Steel sleepers

Cost-effective, long-life, easy-install steel sleepers.

Steel sleepers offer savings on installation time and cost due to their low weight, stackable design and reduced ballast requirement. They offer improved in-service performance too, through enhanced lateral stability and reduced maintenance requirements.

Steel sleepers have a typical lifetime of 50 years and generally have lower maintenance costs over this time. They can be designed to overcome some major engineering challenges. For example, lower height construction can be achieved by eliminating level-adjustment problems in tunnels, as well as over underpasses and can accommodate platform constraints.

Tata Steel sleepers are compatible with all modern fastening systems, including Pandrol, Vossloh and Nabla.

Railway structures

Precision-manufactured components for construction and engineering projects.

As a major, diversified steel producer, Tata Steel manufactures a vast array of steel products used throughout the rail industry.

Structural sections, tubes and steel cladding can be used to construct the full range of railway buildings, from stations to office blocks. These essential structural components offer all the benefits of long life, high strength, dimensional accuracy and ease of installation that make steel the first-choice building material for today's sustainable construction industry.

Steel sections are also used to construct catenary gantries on electrified railway lines, as well as signalling gantries, bridges and other track-side structures.

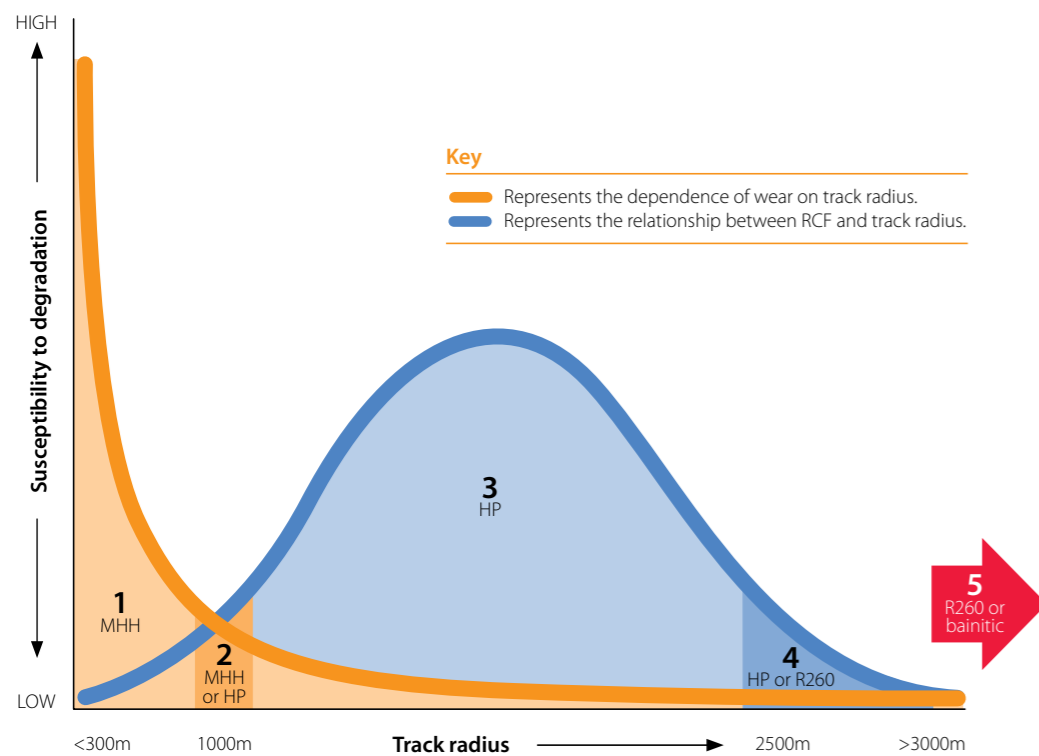
Modular steel platforms provide a fast, cost-effective way to construct train platforms, even in the most challenging site conditions. The use of standardised, lightweight galvanised steel components allows these systems to be installed quickly and with minimal noise and waste – creating a robust, long-lasting solution suitable for all platform profiles. Modular steel construction can also be used to create entire stations quickly, cost effectively and sustainably.

Please contact us at rail@tatasteel.com for more information about any of our rail and related steel products.

GRADE SELECTION

Tata Steel took a leading role in Innotrack, a European project that produced a comprehensive guideline for the selection of rail grades. We have further developed the rail grade selection process by combining knowledge of degradation mechanisms with the metallurgical attributes of rail grades, helping customers to maximise rail life.

Generic grade selection graph



The graph opposite illustrates the Tata Steel grade selection process.

Area 1 represents very tight curves requiring the most wear-resistant steel combined with effective lubrication to maximise rail life. The recommended grade is MHH.

Area 2 is where both wear and rolling contact fatigue are relevant degradation mechanisms. The recommended grade for this region is either MHH or HPrail. The choice will be governed by the observed severity of wear and RCF and the traffic characteristics.

Area 3 represents the area where RCF is the dominant degradation mechanism. The total width of this area is between track radii of 1,000m and 2,500m and would represent a range of vehicle types. The height of this area will largely depend on the proportion of more

damaging stiffer vehicles in the traffic mix. Although the recommended grade is HPrail, use of MHH in part of this area would be technically plausible.

Area 4 is an overlap area, since RCF susceptibility is observed in track radii up to 2,500m in some European mixed traffic networks, while in others RCF susceptibility can extend to 3,000m radius or beyond. Hence, a degree of flexibility in the recommendation of the optimum rail grade is desirable. Thus, HPrail grade should be preferred if the track is known to be susceptible to RCF. The additional cost of this premium grade can be easily offset by savings in the required frequency of grinding to control RCF propagation.

Area 5 represents standard rail grades which usually provide a cost effective solution. However where there is a high susceptibility to rolling contact fatigue then bainitic rail offers an effective solution that reduces the need for grinding.

MHH

A patented heat treatment process at Hayange creates a range of rail products with enhanced hardness, including the world's most wear-resistant micro head hardened (MHH) grade. As well as increasing steel hardness, the heat treatment creates rail with extremely low residual stresses delivering a step change in resistance to foot fatigue.

HPrail

A metallurgically engineered steel with superb resistance to wear and rolling contact fatigue, to maximise rail life and reduce grinding requirements.

Bainitic rail

Low carbon carbide-free bainitic rail offers excellent resistance to rolling contact fatigue. It is proven for switch and crossing applications and shallow radius track with high susceptibility to rolling contact fatigue.

Tata Steel makes the full range of steel grades in compliance with euronorms, AREMA and the specifications of all major railways.

TECHNICAL SERVICES

The rail technology specialists at Tata Steel offer a comprehensive range of services to help improve operational efficiency and network integrity on both light rail and heavy rail networks.

Our unrivalled rail and metallurgical knowledge, combined with world-class on-site laboratory facilities, enable us to conduct detailed materials and product testing on behalf of customers. Our investigations can provide rail operators with the necessary approvals and information to guide future development.

The range of rail technical and consultancy services available includes:

Light rail

Tata Steel carries out detailed condition surveys and provides reports covering all aspects of fixed infrastructure. This effectively benchmarks the assets by, for example, assessing rail degradation due to wear and corrugation.

Heavy rail

We can advise network operators on the most cost-effective material selection and design for new track installations, as well as adding value to maintenance strategies for existing infrastructure.

Metallurgy and materials technology

Experienced metallurgists and materials technologists help to design and select track system components to meet specific duty requirements. The team works closely with network operators and maintainers to enhance network performance and safety.

Failure analysis

Our extensive knowledge of rail steel metallurgy and understanding of fracture mechanics enables us to provide a comprehensive range of investigative services to establish the root causes of failure, as well as recommending corrective and preventative actions.

Track system modelling

Tata Steel modelling specialists combine site information with proven track behaviour data, offering a fast, cost-effective method of track modelling. Our sophisticated modelling tools enable us to determine future defects and consequences of future track degradation, helping customers to develop cost-effective maintenance and renewal policies.

Track monitoring

Our multi-disciplined team has many years' experience of monitoring the in-service performance of rail networks. Monitoring techniques range from detailed visual inspections to using precise instrumentation and non-destructive testing. The findings can be used to identify causes and rates of degradation, helping rail operators to develop appropriate techniques for controlling track quality.

Welding technology

Our welding technology consultancy service helps customers to reduce weld maintenance costs and extend rail life. We can develop welding schedules designed to control weld geometry, optimise weld process control and enhance process monitoring and analysis.

Laboratory testing

We can conduct a range of standard laboratory tests to international standards, as well as designing and building bespoke test arrangements. These provide customers with independent certification of the performance of safety-critical railway components. Laboratory testing can also be used to investigate the performance of worn components.

Noise and vibration monitoring

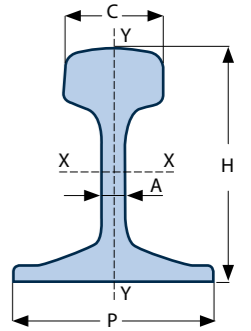
Noise and vibration is a concern for many tramway systems that operate in urban environments. Tata Steel specialists can carry out detailed noise and vibration analyses, provide detailed reports and, where appropriate, recommend solutions for reducing noise or vibration.

Asset management

Our theoretical and practical investigative techniques can be applied to enhance understanding of the in-service performance of complete railway systems. This asset data can be used to support informed decisions about inspection maintenance and renewal activities.



TECHNICAL DATA



EN13674-1 2011 Flat bottom rails >46kg/m

| Rail profile | Equivalent profile name | Section weight kg/m | Rail height mm (H) | Head width mm (C) | Web thickness mm (A) | Foot width mm (P) | Moment of inertia I _{xx} , cm ⁴ | Moment of inertia I _{yy} , cm ⁴ |
|--------------|-------------------------|---------------------|--------------------|-------------------|----------------------|-------------------|---|---|
| 46E1 | SBB I | 46.17 | 145 | 65 | 14 | 125 | 1,641 | 298 |
| 46E2 | U33 | 46.27 | 145 | 62 | 15 | 134 | 1,643 | 329 |
| 46E3 | NP 46 | 46.66 | 142 | 73.72 | 14 | 120 | 1,606 | 308 |
| 49E1 | DIN S49 | 49.39 | 149 | 67 | 14 | 125 | 1,817 | 319 |
| 50E1 | U50E | 50.37 | 153 | 65 | 15.5 | 134 | 1,988 | 365 |
| 50E2 | 50EB-T | 49.97 | 151 | 72 | 15 | 140 | 1,989 | 408 |
| 50E3 | BV 50 | 50.01 | 155 | 70 | 14 | 133 | 2,058 | 351 |
| 50E5 | 50 UNI | 49.94 | 148 | 67 | 14 | 135 | 1,844 | 362 |
| 50E6 | U 50 | 50.9 | 153 | 65 | 15.5 | 140 | 2,018 | 397 |
| 52E1 | 52 RTP | 52.15 | 150 | 65 | 15 | 150 | 1,971 | 434 |
| 54E1 | UIC 54 | 54.77 | 159 | 70 | 16 | 140 | 2,338 | 419 |
| 54E2 | UIC 54 E | 53.82 | 161 | 67.01 | 16 | 125 | 2,308 | 342 |
| 54E3 | DIN S54 | 54.57 | 154 | 67 | 16 | 125 | 2,074 | 355 |
| 54E4 | - | 54.31 | 154 | 67 | 16 | 125 | 2,056 | 353 |
| 54E5 | 54E1HC | 54.42 | 159 | 70.2 | 16 | 140 | 2,308 | 416 |
| 55E1 | U55 | 56.03 | 155 | 62 | 19 | 134 | 2150.4 | 418.4 |
| 56E1 | BR113A | 56.27 | 158.75 | 69.85 | 20 | 140 | 2320.9 | 421.6 |
| 60E1 | UIC 60 | 60.21 | 172 | 72 | 16.5 | 150 | 3,038 | 512 |
| 60E2 | - | 60.03 | 172 | 72 | 16.5 | 150 | 3021.5 | 510.5 |

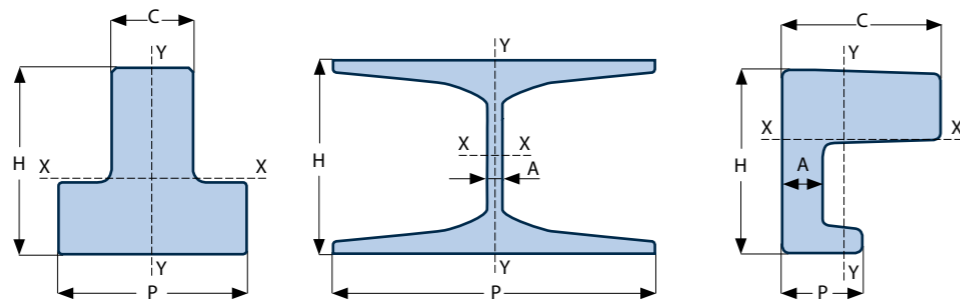
AREMA

| Rail profile | Equivalent profile name | Section weight kg/m | Rail height mm (H) | Head width mm (C) | Web thickness mm (A) | Foot width mm (P) | Moment of inertia I _{xx} , cm ⁴ | Moment of inertia I _{yy} , cm ⁴ |
|--------------|-------------------------|---------------------|--------------------|-------------------|----------------------|-------------------|---|---|
| 100 RE | - | 50.4 | 152.4 | 65.45 | 14.29 | 136.53 | 2,021 | 387 |
| 100 CP-RE | - | 50.86 | 153.99 | 65.6 | 14.29 | 136.53 | 2,065 | 387 |
| 115RE | - | 56.82 | 168.28 | 68.04 | 15.88 | 139.7 | 2,726 | 446 |
| 115 RE 10 | - | 56.98 | 168.28 | 68 | 15.88 | 139.7 | 2,742 | 447 |
| 119RE | - | 58.96 | 173.04 | 66.5 | 15.88 | 139.7 | 2,972 | 452 |
| 132 RE | - | 65.39 | 180.98 | 75.17 | 16.67 | 152.4 | 3,658 | 598 |
| 133 RE | - | 66.19 | 179.39 | 73.02 | 17.46 | 152.4 | 3,589 | 601 |
| 136 OP | - | 67.26 | 185.74 | 74.01 | 17.46 | 152.4 | 3,910 | 598 |
| 136 RE | - | 67.49 | 185.74 | 73.74 | 17.46 | 152.4 | 3,921 | 602 |
| 136 RE 10 | - | 67.49 | 185.74 | 73.77 | 17.46 | 152.4 | 3,923 | 601 |
| 136 RE 14 | - | 67.76 | 185.74 | 73.71 | 17.46 | 152.4 | 3,955 | 604 |
| 136 CN04 | - | 67.71 | 186.53 | 73.74 | 17.46 | 152.4 | 3,949 | 602 |
| 141 RE | - | 69.88 | 188.91 | 74.32 | 17.46 | 152.4 | 4,181 | 621 |

Other rail profiles are available please contact us and we would be pleased to discuss your requirements.

UIC, ASCE & other specifications

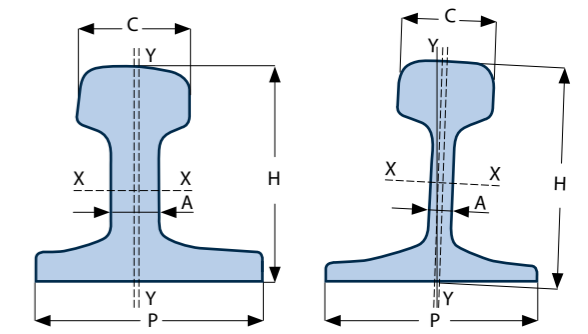
| Rail profile | Equivalent profile name | Section weight kg/m | Rail height mm (H) | Head width mm (C) | Web thickness mm (A) | Foot width mm (P) | Moment of inertia I _{xx} , cm ⁴ | Moment of inertia I _{yy} , cm ⁴ |
|--------------|-------------------------|---------------------|--------------------|-------------------|----------------------|-------------------|---|---|
| BCK 40 | 40KDL | 39.76 | 130 | 62 | 13 | 120 | 1,139 | 243 |
| 80 ASCE | - | 39.87 | 127 | 63.5 | 13.89 | 127 | 1,101 | 220 |
| 85 ASCE | - | 42.19 | 131.76 | 65.09 | 14.29 | 131.76 | 1,256 | 288 |
| 90 RAA | - | 44.48 | 142.88 | 62.81 | 14.29 | 130.18 | 1,567 | 308 |
| BS 90R | - | 44.59 | 142.88 | 66.68 | 13.89 | 136.53 | 1,588 | 335 |
| 43 CHINE | - | 44.6 | 140 | 70 | 14.5 | 114 | 1,481 | 258 |
| BS 90 AM | - | 44.91 | 142.88 | 67.17 | 13.89 | 127 | 1,551 | 284 |
| BS 95 N | - | 47.26 | 147.64 | 69.85 | 13.89 | 139.7 | 1,790 | 354 |
| SAR 48 | - | 48.07 | 150 | 127 | 14 | 68 | 1,855 | 323 |
| 50 CHINE | - | 51.5 | 152 | 70 | 15.5 | 132 | 2,027 | 375 |
| IRS 52 | - | 51.74 | 155.97 | 67.07 | 15.48 | 136.13 | 2,108 | 357 |
| SAR 57 | - | 57.44 | 165 | 71.31 | 16 | 140 | 2,648 | 442 |
| AS 60 | - | 60.64 | 170 | 70 | 16.5 | 146 | 2,926 | 490 |
| 60 CHINE | - | 60.8 | 176 | 70.79 | 16.5 | 150 | 3,217 | 524 |
| 122 CB | - | 60.98 | 172.24 | 72.53 | 16.67 | 152.4 | 3,065 | 528 |
| 124 JK | - | 61.47 | 174.63 | 73.48 | 15.88 | 139.7 | 3,164 | 482 |
| R 65 | - | 64.87 | 180 | 73 | 18 | 150 | 3,543 | 568 |



Special rail sections

| Rail profile | Equivalent profile name | Section weight kg/m | Rail height mm (H) | Head width mm (C) | Web thickness mm (A) | Foot width mm (P) | Moment of inertia I _{xx} , cm ⁴ | Moment of inertia I _{yy} , cm ⁴ |
|----------------------|-------------------------|---------------------|--------------------|-------------------|----------------------|-------------------|---|---|
| BS95RBH | - | 47.07 | 145.26 | 69.85 | 19.05 | 69.85 | 1458 | 171 |
| Section 75 Conductor | - | 75.17 | 138 | 89 | 22.5 | 140 | 2164.08 | 891.64 |
| Section 65 Conductor | - | 65.41 | 102 | 89 | 70 | 70 | 677 | 484 |
| T 52 | - | 52.41 | 100.5 | 45 | - | 101 | 543.8 | 376.2 |
| MATRA | - | 62.85 | 120 | - | 12 | 250 | 1998 | 2887 |
| RATP | - | 68.33 | 140 | - | 12 | 230 | 2518.9 | 2926.6 |
| 33C1 | U69, UIC33, RL 1-60 | 33 | 92.81 | 80 | 20 | 40 | 297 | 219 |

Other rail profiles are available please contact us and we would be pleased to discuss your requirements.



EN 13674-2:2006+A1:2010 (E) Switch and crossing asymmetric rails

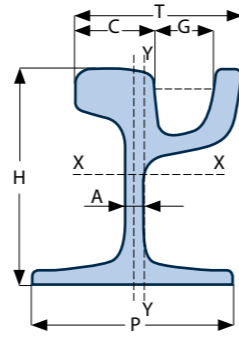
| Rail profile | Equivalent profile name | Section weight kg/m | Rail height mm (H) | Head width mm (C) | Web thickness mm (A) | Foot width mm (P) | Moment of inertia I _{xx} , cm ⁴ | Moment of inertia I _{yy} , cm ⁴ |
|--------------|-------------------------|---------------------|--------------------|-------------------|----------------------|-------------------|---|---|
| 54E1A1 | A69, UIC54B, Zu UIC54B | 68.95 | 129 | 70 | 40 | 147 | 1,544 | 768 |
| 60E1A1 | A73, UIC60B, Zu 1-60 | 72.97 | 134 | 72 | 44 | 140 | 1,727 | 741 |
| 50E6A1 | U59 | 64.98 | 155 | 65 | 28 | 142 | 2,327 | 551 |
| 50E6A2 | U60 | 54.21 | 155 | 65 | 16 | 148 | 2,213 | 497 |
| 54E1A3 | 54D20 | 68.62 | 129 | 69.91 | 32.5 | 145 | 1,553 | 773 |
| 54E1A4 | 54D40 | 68.72 | 129 | 69.98 | 32.5 | 145 | 1,562 | 771 |
| 60E1A4 | 60D | 69.83 | 142 | 71.91 | 32.5 | 150 | 2,026 | 764 |
| 60E1A5 | 60D40 | 69.95 | 142 | 71.98 | 32.5 | 150 | 2,036 | 764 |
| 60E2A2 | Zu60E2-40 | 72.82 | 134.07 | 72.03 | 44 | 140 | 1,718 | 740 |

EN 13674-2:2006+A1:2010 (E) Switch and crossing symmetric thick web rails

| Rail profile | Equivalent profile name | Section weight kg/m | Rail height mm (H) | Head width mm (C) | Web thickness mm (A) | Foot width mm (P) | Moment of inertia I _{xx} , cm ⁴ | Moment of inertia I _{yy} , cm ⁴ |
|--------------|-------------------------|---------------------|--------------------|-------------------|----------------------|-------------------|---|---|
| 60E1T1 | A61, UIC60C | 61.1 | 142 | 72 | 28 | 150 | 1,867 | 520 |
| 50E2T1 | A63, EB63T | 62.97 | 151 | 72 | 30 | 140 | 2,166 | 493 |
| 54E1T1 | A65, UIC54A | 65.41 | 159 | 70 | 28 | 140 | 2,514 | 504 |
| 60E1T2 | A74, UIC60A | 74.24 | 172 | 72 | 30 | 150 | 3,301 | 615 |

EN 13674-4:2006+A1:2009 (E) – Flat bottom rails 27kg/m to 46kg/m

| Rail profile | Equivalent profile name | Section weight kg/m | Rail height mm (H) | Head width mm (C) | Web thickness mm (A) | Foot width mm (P) | Moment of inertia I _{xx} , cm ⁴ | Moment of inertia I _{yy} , cm ⁴ |
|--------------|-------------------------|---------------------|--------------------|-------------------|----------------------|-------------------|---|---|
| 35E1 | Xa | 35.76 | 125 | 58 | 12 | 110 | 936 | 175 |
| 36E2 | 36 kg (S-40) | 36.59 | 128 | 58.27 | 13 | 115 | 1,020 | 203 |
| 39E1 | BS80A | 39.77 | 133.35 | 63.5 | 13.1 | 117.47 | 1,205 | 220 |
| 40E1 | S41 R14 | 40.95 | 138 | 67 | 12 | 125 | 1,367 | 262 |
| 41E1 | S41 R10 | 41.24 | 138 | 67 | 12 | 125 | 1,382 | 265 |
| 45E1 | BS 90A | 45.11 | 142.88 | 66.67 | 13.89 | 127 | 1,564 | 285 |
| 45E2 | DSB 45 | 45.51 | 141 | 69.3 | 13.76 | 126 | 1,536 | 297 |



EN 14811:2006+A1:2009 (E) Grooved rails

| Rail profile | Equivalent profile name | Section weight kg/m | Rail height mm (P) | Head width mm (C) | Web thickness mm (A) | Foot width mm (P) | Moment of inertia, I_{xx} , cm^4 | Moment of inertia, I_{yy} , cm^4 | Groove Width G mm | Total head width T mm |
|--------------|-------------------------|---------------------|--------------------|-------------------|----------------------|-------------------|--------------------------------------|--------------------------------------|-------------------|-----------------------|
| 46 G1 | 60 G G | 46.03 | 150 | 53.76 | 11 | 140 | 1,615 | 611 | 58.85 | 125 |
| G 51 | – | 50.79 | 152 | 51.92 | 12 | 149 | 1,870 | 712 | 62.24 | 126 |
| | Ri54N | 53.98 | 152.5 | 56.2 | 13 | 141.5 | 2,043 | 676 | 36 | 112.9 |
| 55G1 | 35GP G | 54.78 | 152.5 | 56.23 | 13 | 141.5 | 2,076 | 682 | 35.94 | 111.82 |
| | 35 GPU | 53.68 | 152.5 | 56.16 | 13 | 141.5 | 2,041 | 675 | 36.09 | 111.82 |
| | 35 G-A | 54.6 | 151.5 | 56.85 | 13 | 141.5 | 2,013 | 670 | 34.7 | 111.32 |
| | 35 GP13 | 54.71 | 152.5 | 56.61 | 13 | 141.5 | 2,072 | 682 | 35.18 | 111.82 |
| | 35 G-TF | 55.33 | 152.5 | 56.23 | 13 | 141.5 | 2,060 | 673 | 35.95 | 111.32 |
| | 35 G-SF | 55.72 | 152.4 | 56.2 | 13 | 139.7 | 2,064 | 674 | 34 | 111.32 |
| | 35 Gm | 55.78 | 152.5 | 56.23 | 13 | 141.5 | 2,088 | 690 | 35.95 | 111.82 |
| 55G2 | 41 GP G | 55.33 | 152.5 | 56.23 | 13 | 141.5 | 2,082 | 741 | 40.94 | 116.82 |
| | 41 GP13 | 55.27 | 152.5 | 57.03 | 13 | 141.5 | 2,078 | 740 | 40.18 | 116.82 |
| | 41 GPi | 54.09 | 152.5 | 56.22 | 13 | 141.5 | 2,037 | 734 | 40.83 | 116.82 |
| | 41 GPU | 54.26 | 152.5 | 56.16 | 13 | 141.5 | 2,048 | 733 | 41.09 | 116.82 |
| | 41 G | 56.28 | 152.5 | 56.2 | 13 | 141.5 | 2,095 | 749 | 34.7 | 111.32 |
| 59R1 | Ri 59-R10, Ri 59 R | 58.97 | 180 | 56 | 12 | 180 | 3,267 | 886 | 42 | 113 |
| 59R2 | Ri 59-R13, Ri 59N R | 58.19 | 180 | 55.83 | 12 | 180 | 3,214 | 877 | 42.35 | 113 |
| 60R1 | Ri 60-R10, Ri 60 R | 60.59 | 180 | 56 | 12 | 180 | 3,354 | 929 | 35 | 113 |
| 60R2 | Ri 60-R13, Ri 60 N R | 59.75 | 180 | 55.83 | 12 | 180 | 3,299 | 920 | 36.35 | 113 |
| 62R1 | NP4aM R | 62.37 | 180 | 56.03 | 12 | 180 | 3,536 | 1,042 | 34.44 | 116 |
| 62R2 | NP4aS R | 61.91 | 180 | 55.86 | 12 | 180 | 3,506 | 1,043 | 33.98 | 116 |
| 68G1 | 70 G G | 68.3 | 200 | 58 | 13 | 180 | 4,448 | 1,356 | 69.57 | 146 |
| | VKRi60M | 73.04 | 180 | 0 | 12 | 180 | 3,961 | 1,060 | 0 | 114 |

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