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Technical Sheets

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System DFF 21

Highly elastic rail fastening for conventional rail and metro – the optimum single support point for slab track

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System DFF 21

Highly elastic rail fastening for conventional rail and metro –
the optimum single support point for slab track

Vossloh Fastening Systems

Based on our experience we are setting standards of the future.

Conventional Rail – Safety on standard routes

Safety and comfort are decisive for rail traffic. Our tension clamps provide a stable fastening solution for types of track with a permissible axle load of up to 26 tonnes (29 tons). The highly elastic components additionally ensure a comfortable journey.

Urban Transport – Always smooth with stop and go

Frequent braking and starting on many stops within the shortest time characterize urban transport. In this case, highly elastic components provide for comfortable travelling at high operating safety and reduced noise nuisance – at axle loads of up to 18 tonnes (20 tons) for Metro / 13 tonnes (15 tons) for Tram.

Direct fastening on slab track

Slab track systems must meet special requirements to deflect forces generated by a rolling train into the ground in a smoothly and material-saving way: The highly elastic components of the rail fastening systems must take over the original elasticity of the ballasted track. For system DFF 21, a highly-elastic elastomer-rail pad made of *cellentic* is used in order to achieve that result. In case of single support points, the system's base plates take over the function of concrete ties and their shoulders: they keep the rail in the track and transfer dynamic forces in the substructure.

System DFF 21 – Flexible resource-saving application in the slab track

The DFF 21 system, a single support point with screw-dowel combination for anchoring on slab tracks, is based on the approved tramway system W-Tram. Its reinforced base plate features a bigger surface for traffic load distribution: Since it withstands axle loads up to 26 tonnes (29 tons), it is suitable especially for metro and conventional rail projects. Application in covered track and switches is possible as well. Required material quantities are optimized due to the geometry of the plastic base plate: The high portion of long-lasting plastics ensures corrosion protection and electrical insulation. Compared to steel this light-weight material also provides logistic advantages and an easier handling during installation.

cellentic

cellentic is an elastomer made of EPDM that ensures high stability against many types of chemical attacks. The advantage: the material provides excellent resistance to temperature, aging, and weather conditions as well as it is very stable under permanent load. Components made of *cellentic* optimize the elasticity for a reduction of vibrations and the protection of track.

System DFF 21

Elastic. Safe. Resilient. Flexible.

Angled guide plates keep the rail in the track

The angled guide plates lead the forces introduced into the rail by train in the base plate first and then into the concrete. In this way, the screw-dowel combinations are not loaded by shearing and bending forces. The design additionally supports the *tilting protection.* Different widths can *regulate the gauge.*

Adjustable height

Using height adjustment plates, the *height of the system can be regulated within 20 mm (0.8 in).* With the optimized height adjustment plates *NG* the *cellentic* rail pad rests completely on the bearing face.

The W-shape of the Skl 21 provides safety

For meeting the required *rail creep resistance* two highly elastic, independently acting spring arms steadily hold the rail down; the middle bend acts as an additional *tilting protection.* With its high fatigue strength, it resists the dynamic vertical movements that are caused when the vehicle rolls over the rail. The system is *maintenance-free:* Due to the permanently acting tension, Skl and screw cannot loosen, the middle bend prevents the spring arms from plastic deformation.

cellentic rail pad for high elasticity

The elasticity of the particular *cellentic* material ensures the compensation of vertical forces and with this, *stable rail deflection;* it also damps vibrations and *minimizes the structure-borne noise.*

Securely clamped with screw-dowel combinations

Easy handling for installation and rail maintenance

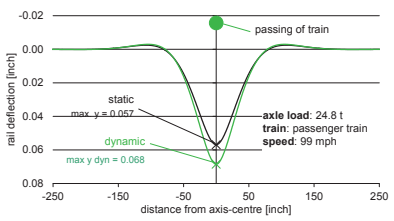
- Flexibly applicable as single support point: no special shoulders (e.g. for concrete ties) required.
- Installation is possible both with top-down and with bottom-up method.
- For welding of the rail, no fastening elements have to be removed from the support point.
- All components can be replaced.

Safety. Comfort. Track protection.

Travel comfort through optimum rail deflection

The railway track must be elastic to compensate forces caused by running trains. Because ballast is not used for slab tracks, the highly-elastic *cellentic*-components of the rail fastening system are designed to undertake this job. The DFF 21 system with *cellentic* rail pad allows rail deflection and can optimally distribute occurring vertical forces. The result: Protection of track. Its elasticity is adapted to the traffic load to achieve optimum rail deflection: load distribution is at the maximum without overloading the rail. Furthermore, the *cellentic* component damps the vibrations caused by the unevenness of track and wheels; structure-borne track vibration is minimized. The result: high travel comfort, high safety through smooth running, as well as long lifetime of track components and vehicles.

Zimmermann computation

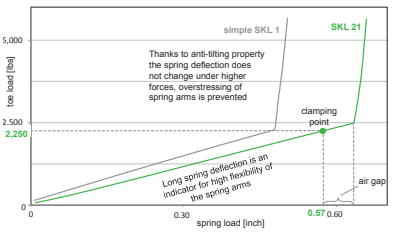


Simplified demonstration: one axle of a two axle bogie

Creep resistance and rail tilting protection

To allow optimum deflection for the rail, its fastening must respond in an elastic way. Therefore, the Skl 21 has a long spring deflection: When force is applied by a train, its spring arms remain in contact with the rail foot in each situation. For this purpose, the rail is continuously clamped in a force-fitted way by the two spring arms with a spring deflection of approx. 14.5 mm (0.57 in) and a toe load of approx. 10 kN (2.25 kip). With this, also a high creep resistance is achieved: When the trains accelerate / decelerate, the rails remain in position; dangerous fracture gaps due to broken rails are avoided. Simultaneously, a small gap between the middle bend and the rail foot of the rail has exactly the play required for operation. If the rail tilts excessively, e.g. in narrow curves, high forces are applied to the tension clamp. The Skl 21 is able to resist them: Rail movements are limited by the middle bend after the gap has been overcome, and the spring arms are not overstretched.

Load-deflection-curve



Rail fastening system DFF 21 with tension clamp Skl 21		
Typical field of application	Conventional Rail/Urban transport/Transit; single support points on slab track	
Axle load	≤ 26 tonnes (29 tons)	
Speed	≤ 250 km/h (155 mph)	
Curve radius	≥ 150 m (500 ft or 12°)	
Height adjustment	+ 20 mm (0.8 in)	
Gauge adjustment	± 10 mm (0.4 in)	
Vertical fatigue strength of Skl 21	2.5 mm (0.10 in)	
Static stiffness of *cellentic* rail pad	≥ 30 kN/mm (170 kip/in)	EN 13146-9:2011
Relation of dyn./stat. stiffness of *cellentic* rail pad	1.1	EN 13146-9:2011
Toe-load of Skl 21 (nominal)	10 kN (2.25 kip)	EN 13146-7: 2012
Electrical resistance	≥ 10 kΩ	EN 13146-5: 2003
Rail creep resistance	≥ 7 kN (1.57 kip)	EN 13146-1: 2012
System approval/homologation		EN 13481-5: 2012

Remark

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www.vossloh-north-america.com

Vossloh Fastening Systems
America Corporation
233 South Wacker Drive, Suite 9730
Chicago, IL 60606, USA

Phone 312.376.3200
Fax 312.376.3252
E-Mail info@vossloh-usa.com

vossloh
North America

System DFF 30 HH

Elastic rail fastening for heavy haul – the optimum single support point for rail vehicles with extreme axle loads

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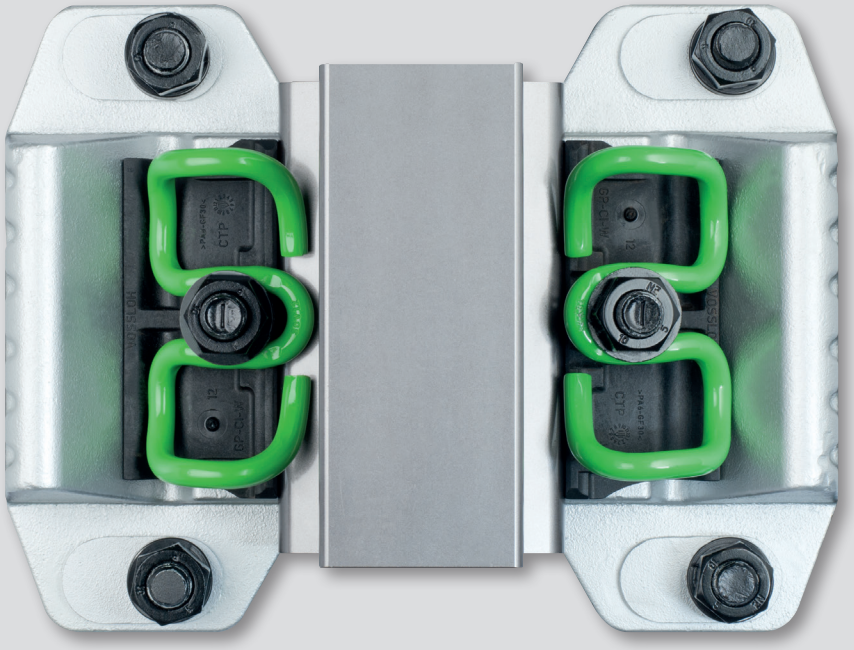


System DFF 30 HH

Elastic rail fastening for heavy haul – the optimum single support point for rail vehicles with extreme axle loads

Vossloh Fastening Systems

Based on our experience we are setting standards of the future.

Heavy Haul – Heavy loads are led safely

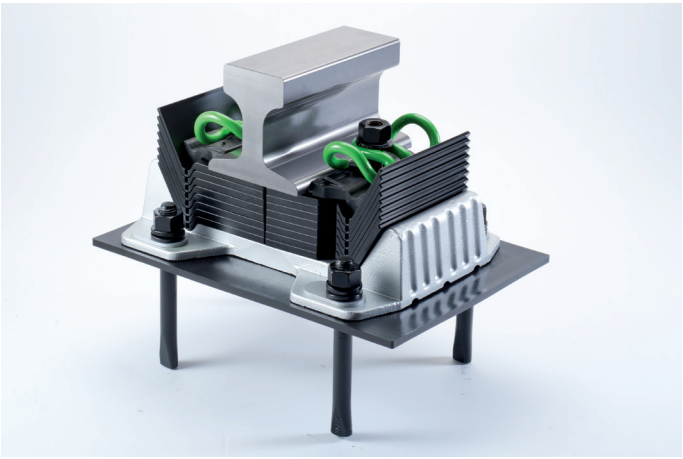
Axle loads of more than 26 tonnes (29 tons) mean extreme loads for the track. Resistant fastening systems provide for safe and durable connections and simultaneously allow fast and easy maintenance.

DFF 30 HH – designed for extreme axle loads of crane railways

In container ports, the stress of the railway infrastructure is extremely high - due to the enormous loads of the container cranes and extreme weather conditions. Especially for the requirements of heavy container crane systems in port terminals – with their high axle and lateral loads, as well as their extreme acceleration and brake forces – Vossloh has developed the DFF 30 HH system, a single support point solution for slab tracks based on the approved systems DFF 300 and W 30 HH. The extreme loads are led via the shoulder of the used cast-iron baseplate and the angled guide plates made of glass-fibre reinforced polyamide. The rail pad made of thermoplastic polyurethane not only damps the loads but also ensures the durability required for extreme loads and ambient conditions.

The DFF 30 HH system offers a height adjustment of up to 80 mm (3.2 in) and a gauge adjustment by 40 mm (1.6 in) per support point, without disassembly of the whole system. This is especially important to be able to respond on sagging of the ground – a problem typical for crane tracks, caused by the different ground textures in the port area and the extreme loads of the heavy cranes. All steel parts are protected from corrosion, so that they can also be used under extreme weather conditions including aggressive saline maritime air.

The DFF 30 HH system is already being used in two Australian projects – Port of Brisbane as well as Port Botany in Sydney.



System DFF 30 HH

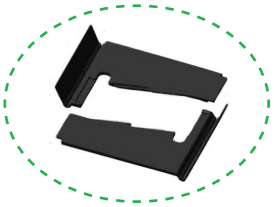
Elastic. Safe. Resilient. Flexible.

The W-shape of the Skl 30 provides safety

For meeting the required *creep resistance* two highly elastic, independently acting spring arms steadily hold the rail down; the middle bend is used as an additional *tilting protection*. With its high fatigue strength, it resists the dynamic vertical movements that are caused when the vehicle rolls over the rail. Due to the permanently acting tension, Skl and screw cannot loosen and therefore, they are *maintenance-free.*

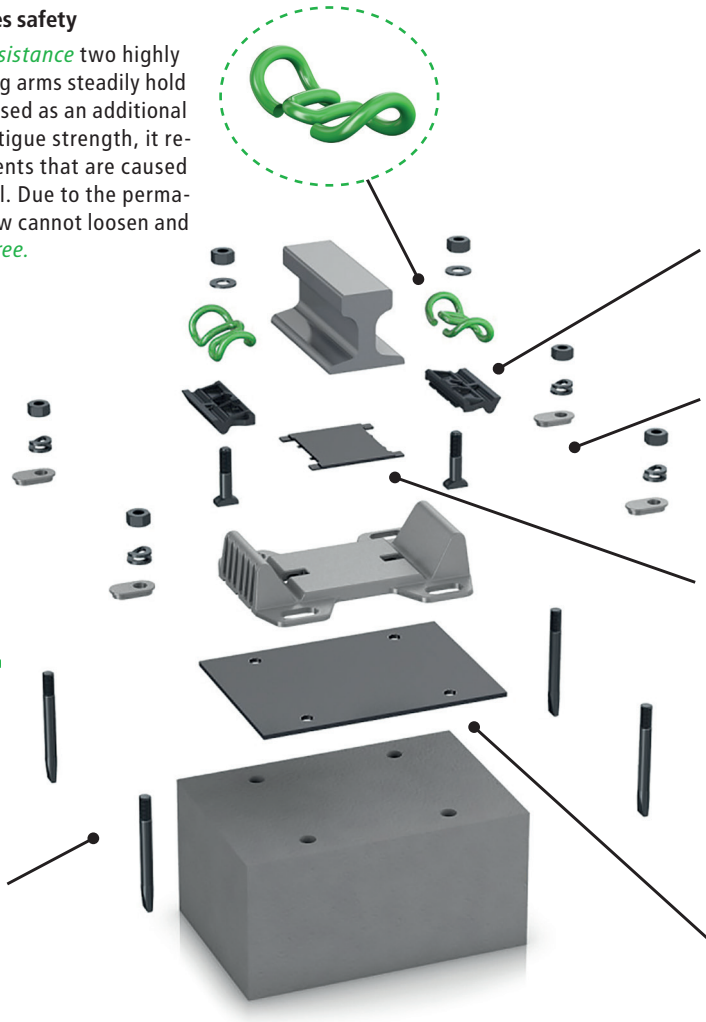
Adjustable height

Using height adjustment plates, the *height of the system can be regulated within 80 mm (3.2 in)*. With the optimized height adjustment plates *NG* the rail pad rests completely on the bearing face.



Safely tied

By means of T-headed bolts, the Skl tension clamps are safely mounted to the baseplate. The baseplate itself is fixed in the concrete track with anchor bolts.



Angled guide plates keep the rail in the track

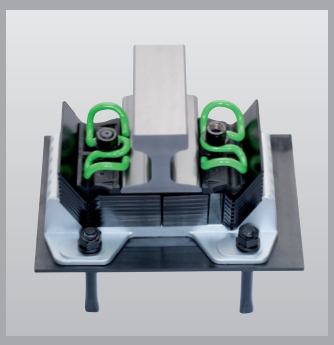
The angled guide plates lead the forces introduced into the rail by train in the baseplate made of cast iron. In this way, the T-headed bolts are not loaded by shearing and bending forces. The design of the angled guide plates additionally supports the *tilting protection*. Different widths can *regulate the gauge.*

The gauge can be adjusted using *adjusting plates.*

Optimum distribution of extreme lateral loads

Due to its adapted shoulder of the cast-iron base plate, extreme *lateral loads can be deflected*. The rail pad made of thermoplastic polyurethane *not only damps the loads* but also ensures the required *durability*. Furthermore, it *electrically insulates* the baseplate from the rail.

Intermediate plate



Easy handling for installation, rail maintenance and replacement

- Flexibly applicable as single supporting point: no special shoulders (e.g. as for concrete sleepers) required.
- Installation is possible both with top-down and with bottom-up method.
- For welding of the rail, no fastening elements have to be removed from the supporting point.
- All components can be replaced.

Safety. Comfort. Track protection.

Creep resistance and rail tilting protection

To allow optimum deflection for the rail, fastening must response in an elastic way. Therefore, the Skl 30 has a long spring deflection: When forces are applied by a train, its spring arms remain in contact with the rail foot in each situation. For this purpose, the rail is continuously clamped in a force-fitted way by the two spring arms with a spring deflection of approx. 14 mm (0.55 in) and a toe load of approx. 12.5 kN (2.8 kip). With this, a high creep resistance is also achieved: When the trains accelerate / decelerate, the rails remain in position, dangerous open fracture gaps due to broken rails are avoided. Simultaneously, a small gap between the middle bend and the rail foot of the rail has exactly the play that is required for operation. If the rail tilts excessively, e.g. in narrow curves, high forces are applied to the tension clamp. The Skl 30 is able to resist them: Rail movements are compensated by the middle bend after the air gap has been overcome, and the spring arms are not overstretched.

Load-deflection-curve

Rail fastening system DFF 30 HH with tension clamp Skl 30		
Typical field of application	Heavy haul / Crane trains; slab track	
Axle load	≤ 72 tonnes (79 tons)	
Speed	≤ 80 km/h (50 mph)	
Curve radius	≥ 300 m (1,000 ft or 6°)	
Height adjustment	+ 80 mm (3.2 in)	
Gauge adjustment	– 10 / + 70 mm (– 0.4 in / + 2.8 in)	
Vertical fatigue strength of Skl 30	2.2 mm (0.09 in)	
Static stiffness of rail pad	≥ 400 kN/mm (2,300 kip/in)	EN 13146-9:2011
Toe load of Skl 30 (nominal)	12.5 kN (2.8 kip)	EN 13146-7: 2012
Electrical resistance	≥ 5 kΩ	EN 13146-5: 2003
Rail creep resistance	≥ 9 kN (2 kip)	EN 13146-1: 2012
System audit / homologation		EN 13481-5: 2012

Remark

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America Corporation
233 South Wacker Drive, Suite 9730
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System DFF 300 UTS

Highly elastic rail fastening for metro –
the optimum single support point for slab track

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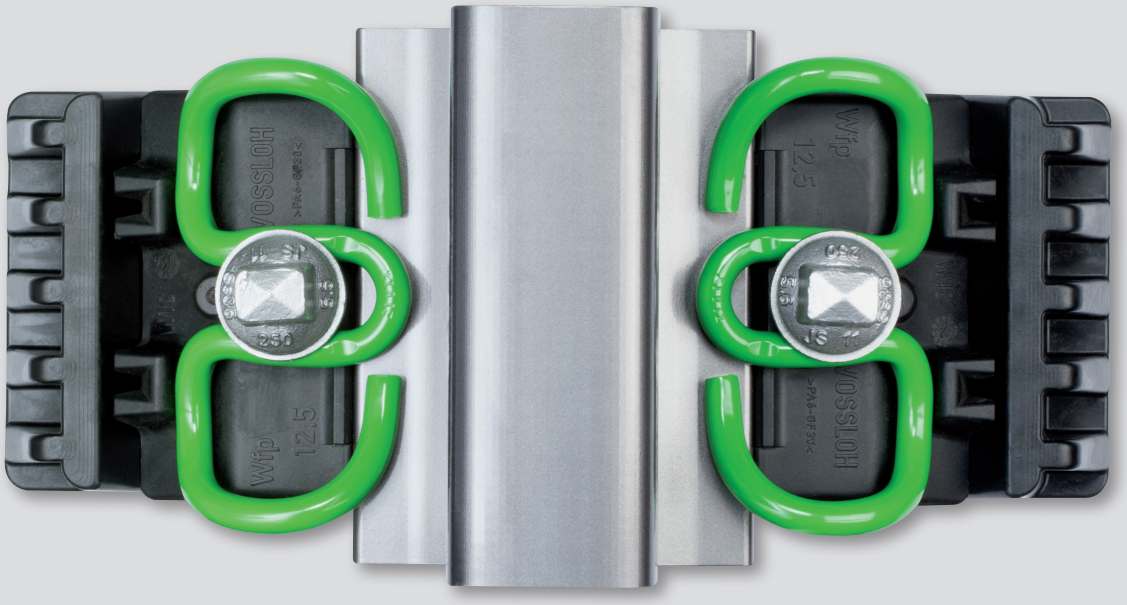


System DFF 300 UTS

Highly elastic rail fastening for metro –
the optimum single support point for slab track

Vossloh Fastening Systems

Based on our experience we are setting standards of the future.

Urban Transport – Always smooth with stop and go

Frequent braking and starting on many stops within the shortest time characterize urban transport. In this case, highly elastic components provide for comfortable travelling at high operating safety and reduced noise nuisance – at axle loads of up to 18 tonnes (20 tons) for Metro/ 13 tonnes (15 tons) for Tram.

Direct fastening on slab track

Slab track systems must meet special requirements to deflect forces generated by a rolling train into the ground in a smooth and material-saving way: The highly elastic components of the rail fastening systems must take over the original elasticity of the ballasted track.

For system DFF 300 UTS, a highly-elastic elastomer-intermediate plate made of *cellentic* is used in order to achieve that result. In case of single support points, the system's base plates take over the function of concrete ties and their shoulders: they keep the rail in the track and transfer dynamic forces in the substructure.

System DFF 300 UTS – Flexible resource-saving application in the slab track

With the DFF 300 UTS system, Vossloh Fastening Systems established a rail fastening system as single support point on a slab track that has been developed on the basis of the approved advantages of the rail fastening system 300 and with this, it has been adapted to the special requirements of urban transport.

Required material quantities are optimized due to the geometry of the plastic base plate.

The high portion of durable plastics ensures corrosion protection and electrical insulation. Compared to steel this light-weight material also provides logistic advantages and an easier, safer handling during installation.

cellentic

cellentic is an elastomer made of EPDM that ensures high stability against many types of chemical attacks. The advantage: the material provides excellent resistance to temperature, aging, and weather conditions as well as it is very stable under permanent load. Components made of *cellentic* optimize the elasticity for a reduction of vibrations and the protection of track.

System DFF 300 UTS

Elastic. Safe. Resilient. Flexible.

The W-shape of the Skl 21 provides safety

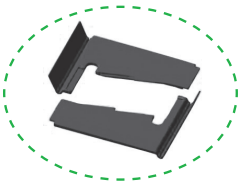
For meeting the required *rail creep resistance* two highly elastic, independently acting spring arms steadily hold the rail down; the middle bend acts as an additional *tilting protection*. With its high fatigue strength, it resists the dynamic vertical movements that are caused when the vehicle rolls over the rail. The system is *maintenance-free:* Due to the permanently acting tension, Skl and screw cannot loosen, the middle bend prevents the spring arms from plastic deformation.

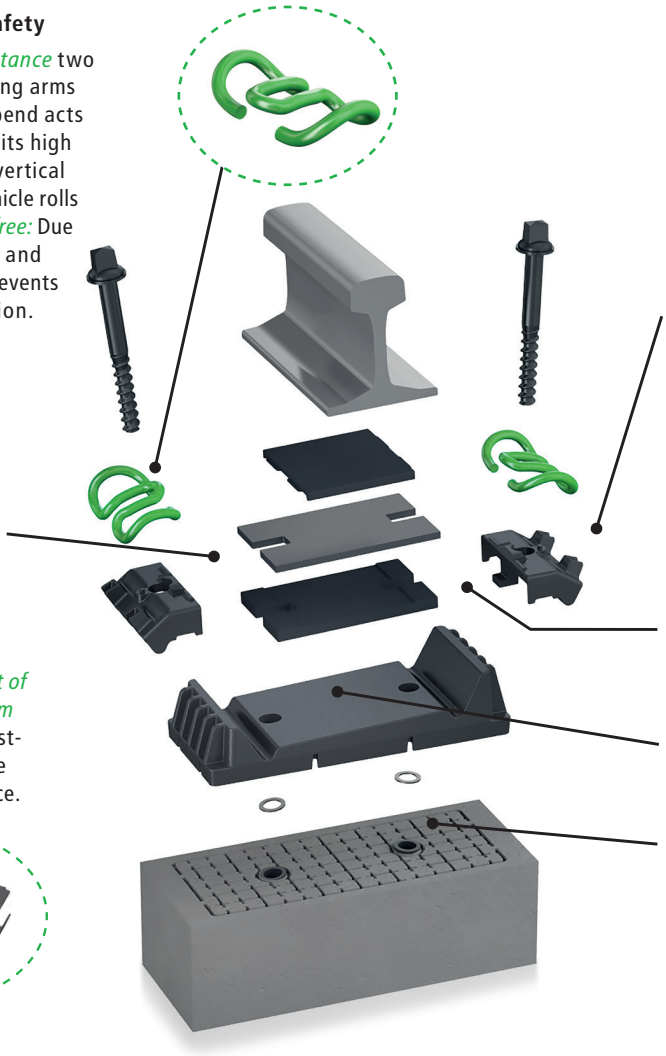
A steel plate ensures an optimum distribution of load

A steel plate provides for *load distribution* from the rail foot to the elastic intermediate plate and offers additional *tilting protection* through its large surface. A plastic rail pad insulates the rail electrically.

Adjustable height

Using height adjustment plates, the *height of the system can be regulated within 30 mm (1.2 in).* With the optimized height adjustment plates *NG* the *cellentic* intermediate plate rests completely on the bearing face.





Angled guide plates keep the rail in the track

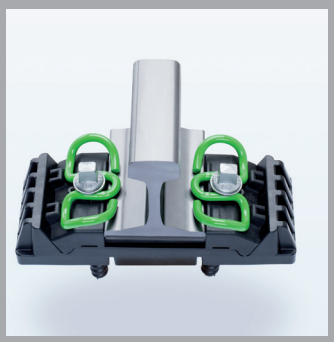
The angled guide plates lead the forces introduced into the rail by train in the base plate first and then into the concrete. In this way, the screw-dowel combinations are not loaded by shearing and bending forces. The design of the angled guide plates additionally supports the *tilting protection.* Different widths can *regulate the gauge.*

Highly-elastic intermediate plate for low vibration

The elasticity of the special *cellentic* material ensures stable rail deflection; *Vibrations and structure-borne noise are minimised*. Their reinforced edge area also contributes to the *tilting protection.*

Base plate

Securely clamped with screw-dowel combinations



Easy handling for installation, rail maintenance and replacement

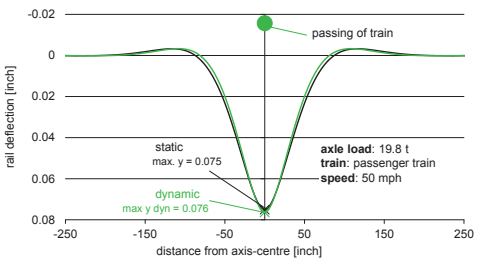
- Flexibly applicable as single support point: no special shoulders (e.g. for concrete ties) required.
- Installation is possible both with top-down and with bottom-up method.
- For welding of the rail, no fastening elements have to be removed from the support point.
- All components can be replaced.

Safety. Comfort. Track protection.

Travel comfort through optimum rail deflection

The railway track must be elastic to compensate forces caused by running trains. Because ballast is not used for slab tracks, the highly-elastic *cellentic* components of the rail fastening system are designed to undertake this job. The DFF 300 UTS system with *cellentic* intermediate plate allows rail deflection and can optimally distribute occurring vertical forces. The result: Protection of track. Its elasticity is adapted to the traffic load to achieve optimum rail deflection: load distribution is at the maximum without overloading the rail. Furthermore, the *cellentic* component damps the vibrations caused by the unevenness of the track and wheels; structure-borne track vibration is minimized. The result: high travel comfort, high safety through smooth running, as well as long lifetime of track components and vehicles.

Zimmermann computation

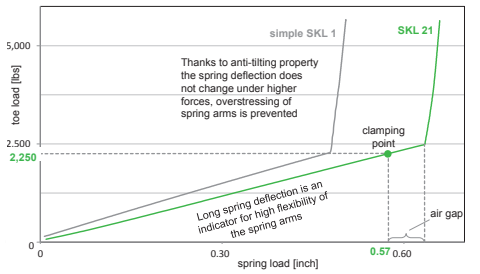


Simplified demonstration: one axle of a two axle bogie

Creep resistance and rail tilting protection

To allow optimum deflection for the rail, its fastening must respond in an elastic way. Therefore, the Skl 21 has a long spring deflection: When force is applied by a train, its spring arms remain in contact with the rail foot in each situation. For this purpose, the rail is continuously clamped in a force-fitted way by the two spring arms with a spring deflection of approx. 14.5 mm (0.57 in) and a toe load of approx. 10 kN (2.25 kip). With this, also a high creep resistance is achieved: When the trains accelerate / decelerate, the rails remain in position; dangerous fracture gaps due to broken rails are avoided. Simultaneously, a small gap between the middle bend and the rail foot of the rail has exactly the play required for operation. If the rail tilts excessively, e.g. in narrow curves, high forces are applied to the tension clamp. The Skl 21 is able to resist them: Rail movements are limited by the middle bend after the gap has been overcome, and the spring arms are not overstretched.

Load-deflection-curve



Rail fastening system DFF 300 UTS with tension clamp Skl 21		
Typical field of application	Urban transport / Transit; single support point on slab track	
Axle load	≤ 18 tonnes (20 tons)	
Speed	≤ 140 km/h (90 mph)	
Curve radius	≥ 80 m (265 ft or 20°)	
Height adjustment	+ 30 mm (1.2 in)	
Gauge adjustment	± 10 mm (0.4 in)	
Vertical fatigue strength of Skl 21	2.5 mm (0.10 in)	
Static stiffness of *cellentic* intermediate plate	≥ 16 kN/mm (90 kip/in)	EN 13146-9:2011
Relation of dyn. / stat. stiffness of *cellentic* intermediate plate	1.1	EN 13146-9:2011
Toe load of Skl 21 (nominal)	10 kN (2.25 kip)	EN 13146-7: 2012
Electrical resistance	≥ 5 kΩ	EN 13146-5: 2003
Rail creep resistance	≥ 9 kN (2 kip)	EN 13146-1: 2012
System audit / homologation		EN 13481-5: 2012

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System 300 *New Generation*

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the sustainable solution for slab track

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Vossloh Fastening Systems

Based on our experience we are setting standards of the future.

High Speed on an elastic base

High speed means high dynamic forces – a test of stamina for the rail fastening system. Vossloh tension clamps for high speed traffic with more than 250 km/h (155 mph) ensure safe tensioning. Highly elastic components compensate acting forces in an outstanding way.

Conventional Rail – Safety on standard routes

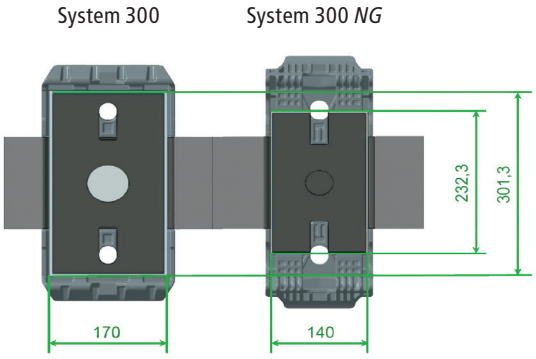
Safety and comfort are decisive for rail traffic. Our tension clamps provide a stable fastening solution for types of track with a permissible axle load of up to 26 tonnes (29 tons). The highly elastic components additionally ensure a comfortable journey.

System 300 *NG* – the optimized sleeper solution for slab tracks

Slab track systems optimally resist forces that are caused by high speed trains – the track bed course does not displace and maintenance costs are reduced. The 300 *NG* system combines these characteristics with the advantages of concrete sleepers: Sleeper shoulders stabilize the system and deflect the forces generated by the traffic. The 300 *NG* system achieves the elasticity required for the railway tracks by its elastomer intermediate plate made of *cellentic* that rests on the rail seat and provides for optimum distribution of load.

Approved quality system – sustainably optimized

Reliable functionality and stability with resource-saving design – this is provided by the new generation of the Vossloh rail fastening systems. The new 300 *NG* system is a further developed design of the approved system 300 and the result of 40 years of experience in high-speed traffic. New angled guide plates, intermediate plates and load distribution plates have been optimally adapted to each other. At the same time, it can be used for existing track and sleeper designs of the system 300 and is offering constant functionality and stability. Optimized usage of material does not only save the environment but also reduces logistic costs. The new components are adapted to the approved Vossloh tension clamp Skl 15 to ensure already established characteristics, e.g. high fatigue strength and high toe load. The highly elastic *cellentic* intermediate plate guarantees saving of the track by optimum load distribution.



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System 300 *NG*

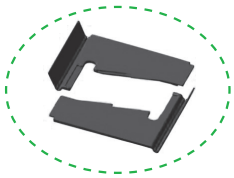
Elastic. Safe. Resilient. Flexible.

The W-shape of the Skl 15 provides safety

For meeting the required *rail creep resistance* two highly elastic, independently acting spring arms steadily hold the rail down; the middle bend acts as an additional *tilting protection*. With its high fatigue strength, it resists the dynamic vertical movements that are caused when the vehicle rolls over the rail. The system is *maintenance-free:* Due to the permanently acting tension, Skl and screw cannot loosen, the middle bend prevents the spring arms from plastic deformation.

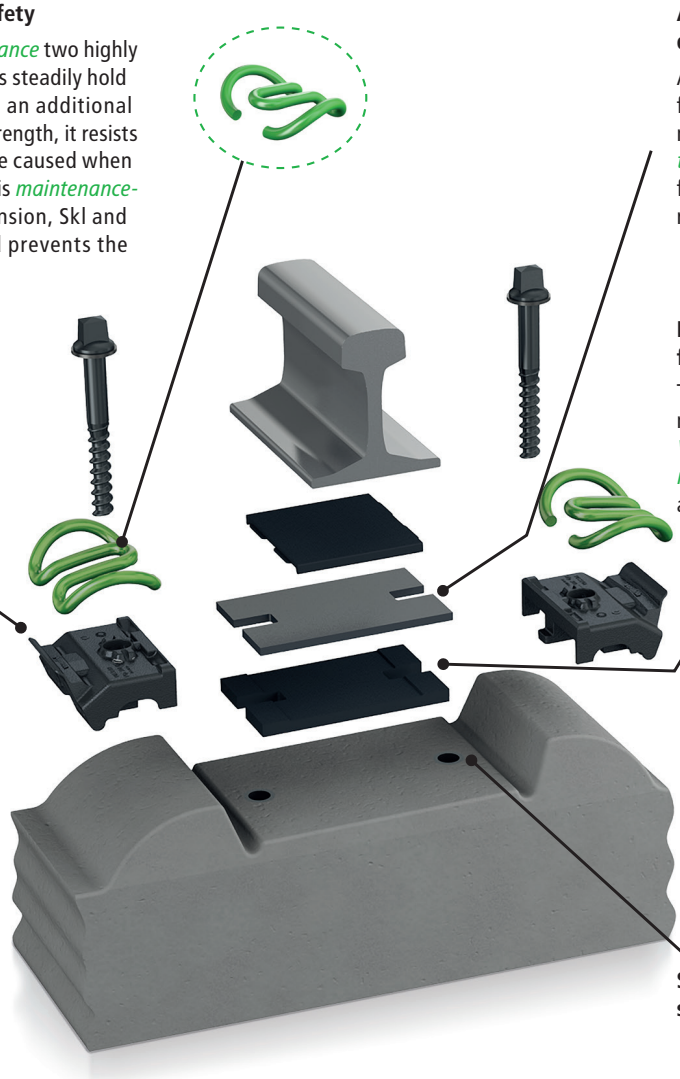
Angled guide plates keep the rail in the track

The angle guide plates lead the forces introduced into the rail by train in the concrete. In this way, the screw-dowel combinations are not loaded by shearing and bending forces. The design of the angled guide plates additionally supports the *tilting protection*. Different widths can *regulate the gauge.*



Adjustable height

Using height adjustment plates, the *height of the system can be regulated within 76 mm (3 in).* With the optimized height adjustment plates *NG* the *cellentic* intermediate plate rests completely on the bearing face.



A steel plate ensures an optimum distribution of load

A steel plate ensures *load distribution* from the rail foot to the elastic intermediate plate and offers additional *tilting protection* through its large surface. A plastic rail pad insulates the rail electrically.

Highly-elastic intermediate plate for less vibration

The elasticity of the special *cellentic* material ensures stable rail deflection; *Vibrations and structure-borne noise are minimised.* Their reinforced edge area also contributes to the *tilting protection.*

Securely clamped with screw-dowel combinations

Easy handling for installation and rail maintenance due to preassembly and exchangeability

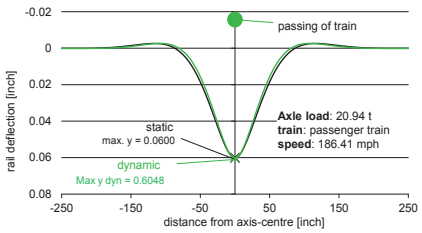
- All parts of the fastening system can be preassembled in the factory for sleepers and prefabricated elements.
- At the construction site, it will only be required to lay the rail and clamp it. That way, fastening components cannot get lost.
- For welding of the rail, no fastening elements have to be removed from the support point.
- All components, including dowels, can be replaced.

Safety. Comfort. Track protection.

Travel comfort through optimum rail deflection

The railway track must be elastic to compensate forces caused by running trains. Because ballast is not used for slab tracks, the highly-elastic *cellentic* components of the rail fastening system are designed to undertake this job. The 300 *NG* system with *cellentic* intermediate plate allows rail deflection and can optimally distribute occurring vertical forces. The result: Proctection of track. Its elasticity is adapted to the traffic load to achieve optimum rail deflection: load distribution is at the maximum without overloading the rail. Furthermore, the *cellentic* component damps the vibrations caused by the unevenness of the track and the wheels; structure-borne track vibration is minimized. The result: high travel comfort, high safety through smooth running, as well as long lifetime of track components and vehicles.

Zimmermann computation

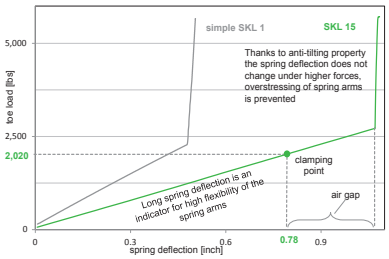


Simplified demonstration: one axle of a two axle bogie

Creep resistance and rail tilting protection

To allow optimum deflection for the rail, its fastening must response in an elastic way. Therefore, the Skl 15 has a long spring deflection: When forces are applied by a train, its spring arms remain in contact with the rail foot in each situation. For this purpose, the rail is continuously clamped in a force-fitted way by the two spring arms with a spring deflection of approx. 20 mm (0.8 in) and a toe load of approx. 9 kN (2 kip). With this, a high rail creep resistance is also achieved: When the trains accelerate / decelerate, the rails remain in position, dangerous open fracture gaps due to broken rails are avoided. Simultaneously, a gap between the middle bend and the rail foot of the rail has exactly the play that is required for operation. If the rail tilts excessively, e.g. in narrow curves, high forces are applied to the tension clamp. The Skl 15 is able to resist them: Rail movements are limited by the middle bend after the air gap has been overcome, and the spring arms are not overstretched.

Load-deflection-curve



Rail fastening system 300 *NG* with tension clamp Skl 15		
Typical field of application	High speed / Conventional rail; slab track with sleepers / supporting plates	
Axle load	≤ 26 tonnes (29 tons)	
Speed	For HS: ≥ 250 km/h (155 mph) // for CR: ≤ 250 km/h (155 mph)	
Curve radius	For HS: ≥ 400 m (1,300 ft or 4°) // for CR: 150 m (500 ft or 12°)	
Height adjustment	-4 mm/ + 76 mm (-0.16 in/ + 3.00 in)	
Gauge adjustment	± 16 mm (±0.64 in)	
Vertical fatigue strength of Skl 15	3.0 mm (0.12 in)	
Static stiffness of *cellentic* intermediate plate	≥ 17 kN/mm (97 kip/in)	EN 13146-9:2011
Relation of dyn. / stat. stiffness of *cellentic* intermediate plate	1.1	EN 13146-9:2011
Toe load of Skl 15 (nominal)	9 kN (2 kip)	EN 13146-7: 2012
Electrical resistance	≥ 5 kΩ	EN 13146-5: 2003
Rail creep resistance	≥ 9 kN (2 kip)	EN 13146-1: 2012
System approval / homologation		EN 13481-5: 2012

Remark

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www.vossloh-north-america.com

Vossloh Fastening Systems
America Corporation
233 South Wacker Drive, Suite 9730
Chicago, IL 60606, USA

Phone 312.376.3200
Fax 312.376.3252
E-Mail info@vossloh-usa.com

vossloh
North America

System W 14

Highly elastic rail fastening for high speed and conventional rail – the established solution for ballasted track with concrete sleeper

vossloh
North America

System W 14

Highly elastic rail fastening for high speed and conventional rail –
the established solution for ballasted track with concrete sleeper

Vossloh Fastening Systems

Based on our experience we are setting standards of the future.

High Speed on an elastic base

High speed means high dynamic forces – a test of stamina for the rail fastening system. Vossloh tension clamps for high speed traffic with more than 250 km/h (155 mph) ensure safe tensioning. Highly elastic components compensate acting forces in an outstanding way.

Conventional Rail – Safety on standard routes

Safety and comfort are decisive for rail traffic. Our tension clamps provide a stable fastening solution for types of track with a permissible axle load of up to 26 tonnes (29 tons). The highly elastic components additionally ensure a comfortable journey.

System W 14 – established solution for concrete sleepers on ballasted tracks

The combination of concrete sleepers on ballast is the most frequently used railway track structure all over the world. In the so-called W-track, sleeper shoulders provide stability for track and fastening system and allow the transfer of forces generated by traffic. The ballast bed is flexible and transfers these loads homogeneously into the substructure. Furthermore, it absorbs noise and vibration caused by rolling trains. The W 14 system completes this railway track perfectly because its elastomer rail pad made of *cellentic* optimizes the elasticity and with this, it contributes to the protection of the track bed.

The original made by Vossloh: the most popular solution for ballasted track for more than 25 years

Developed in the 1980s and installed in Germany for the first time, Vossloh's system W 14 became the most popular fastening system for W-tracks worldwide.

For the first time, the nowadays common way of pre-assembling was possible – due to the back then novel shape of the Skl 14. This revolutionised the track installation; it became easier, faster and therefore less expensive. Additionally, the tension clamp Skl 14 initiated the possibility of using elastic rail pads to improve travelling comfort and the life cycle of track components.

Today transportation companies from more than 50 countries swear by Vosslohs W 14. More than a quarter of a billion fastening points of the system are already installed, equating more than 80.000 km (50.000 miles) track length – a route that could circle the earth twice. By using elastic *cellentic* rail pads, the system is also suitable for high speed traffic – in France, Saudi Arabia and Morocco at speeds up to 320 km/h (200 mph).

cellentic

cellentic is an elastomer made of EPDM that ensures high stability against many types of chemical attacks. The advantage: the material provides excellent resistance to temperature, aging, and weather conditions as well as it is very stable under permanent load. Components made of *cellentic* optimize the elasticity for a reduction of vibrations and the protection of track.

System W 14

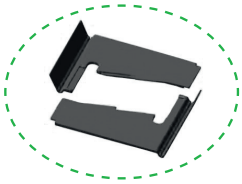
Elastic. Safe. Resilient. Flexible.

The W-shape of the Skl 14 provides safety

For meeting the required *rail creep resistance* two highly elastic, independently acting spring arms steadily hold the rail down; the middle bend acts as an additional *tilting protection*. With its high fatigue strength, it resists the dynamic vertical movements that are caused when the vehicle rolls over the rail. The system is *maintenance-free*: Due to the permanently acting tension, Skl and screw cannot loosen, the middle bend prevents the spring arms from plastic deformation.

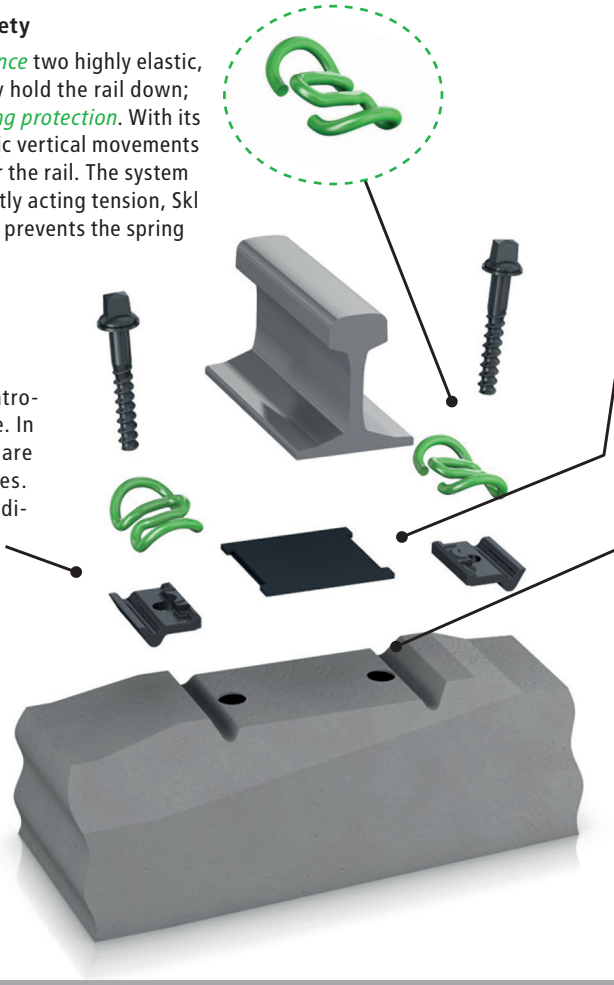
Angled guide plates keep the rail in the track

The angled guide plates lead the forces introduced into the rail by train in the concrete. In this way, the screw-dowel combinations are not loaded by shearing and bending forces. The design of the angled guide plates additionally supports the *tilting protection*. Different widths can *regulate the gauge*.



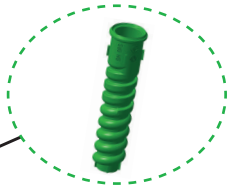
Adjustable height

Using height adjustment plates, the *height of the system can beregulated*. With the optimized height adjustment plates *NG* the *cellentic* rail pad rests completely on the bearing face.



***cellentic* rail pad for high elasticity**

The elasticity of the particular *cellentic* material ensures the compensation of vertical forces and with this, stable rail deflection; it also damps vibrations and *minimizes the structure-borne noise.*



Securely clamped with the screw-dowel combination *NG*

The high-quality dowels made of high-tech material are extremely loadable and efficient: Lateral forces are reduced, this leads to a *decrease in the load on the sleeper.*

Easy handling for installation and rail maintenance due to preassembly and exchangeability

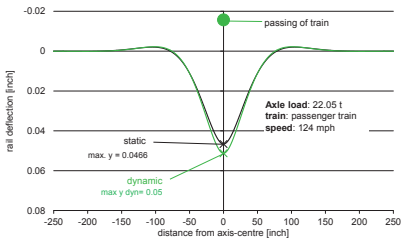
- All fastening components can be preassembled in the sleeper factory.
- At the construction site, it will only be required to lay the rail and clamp it. That way, fastening components cannot get lost.
- Due to the innovative tool VosMat Rapid, an automated installation of the system is possible.
- For welding of the rail, no fastening elements have to be removed from the sleeper.
- All components, including dowels, can be replaced easily. Replacement of sleepers can be avoided.

Safety. Comfort. Track protection.

Travel comfort through optimum rail deflection

The railway track must be elastic to compensate forces caused by running trains. The highly elastic *cellentic* components of the fastening system take over this job in addiation to the ballast. The W 14 system with *cellentic* rail pad allows rail deflection and can optimally distribute occurring vertical forces. The result: Protection of track. Its elasticity is adapted to the traffic load to achieve optimum rail deflection: load distribution is at the maximum without overloading the rail. Furthermore, the *cellentic* component damps the vibrations caused by the unevenness of the track and the wheels; structure-borne track vibration is minimized. The result: high travel comfort, high safety through smooth running, as well as long lifetime of track components and vehicles.

Zimmermann computation

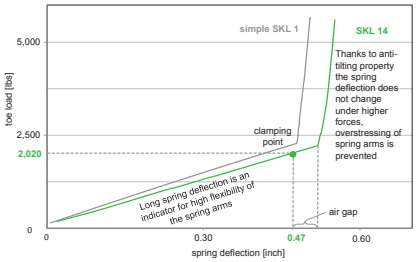


Simplified demonstration: one axle of a two axle bogie

Creep resistance and rail tilting protection

To allow optimum deflection for the rail, its fastening must respond in an elastic way. Therefore, the Skl 14 has a long spring deflection: When force is applied by a train, its spring arms remain in contact with the rail foot in each situation, also when the rail deflects. For this purpose, the rail is continuously clamped in a force-fitted way by the two spring arms with a deflection of approx. 12 mm (0.47 in) and a toe load of approx. 9 kN (2 kip). With this, also a high creep resistance is achieved: When the trains accelerate/decelerate, the rails remain in position, dangerous open fracture gaps due to broken rails are avoided. Simultaneously, a small gap between the middle bend and the rail foot of the rail has exactly the play required for operation. If the rail tilts excessively, e.g. in narrow curves, high forces are applied to the tension clamp. The Skl 14 is able to resist them: Rail movements are limited by the middle bend after the gap has been overcome, and the spring arms are not overstretched.

Load-deflection-curve



Rail fastening system W 14 with tension clamp Skl 14		
Typical field of application	High speed/Conventional rail; ballasted track with concrete sleepers	
Axle load	≤ 26 tonnes (29 tons)	
Speed	For HS: ≥ 250 km/h (155 mph) // for CR: ≤ 250 km/h (155 mph)	
Curve radius	For HS: ≥ 400 m (1.300 ft or 4°) // for CR: ≥ 150 m (500 ft or 12°)	
Height adjustment	optional	
Gauge adjustment	± 10 mm (0.4 in)	
Vertical fatigue strength of Skl 14	2 mm (0.08 in)	
Static stiffness of *cellentic* rail pad	≥ 50 kN/mm (285 kip/in)	EN 13146-9:2011
Relation of dyn./stat. stiffness of *cellentic* rail pad	1.1	EN 13146-9:2011
Toe load of Skl 14 (nominal)	9 kN (2 kip)	EN 13146-7: 2012
Electrical resistance	≥ 5 kΩ	EN 13146-5: 2003
Rail creep resistance	≥ 9 kN (2 kip)	EN 13146-1: 2012
System approval/homologation		EN 13481-2: 2012

Remark

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System W 21

Highly elastic rail fastening for high speed and conventional rail – the modern solution for ballasted track with concrete sleeper

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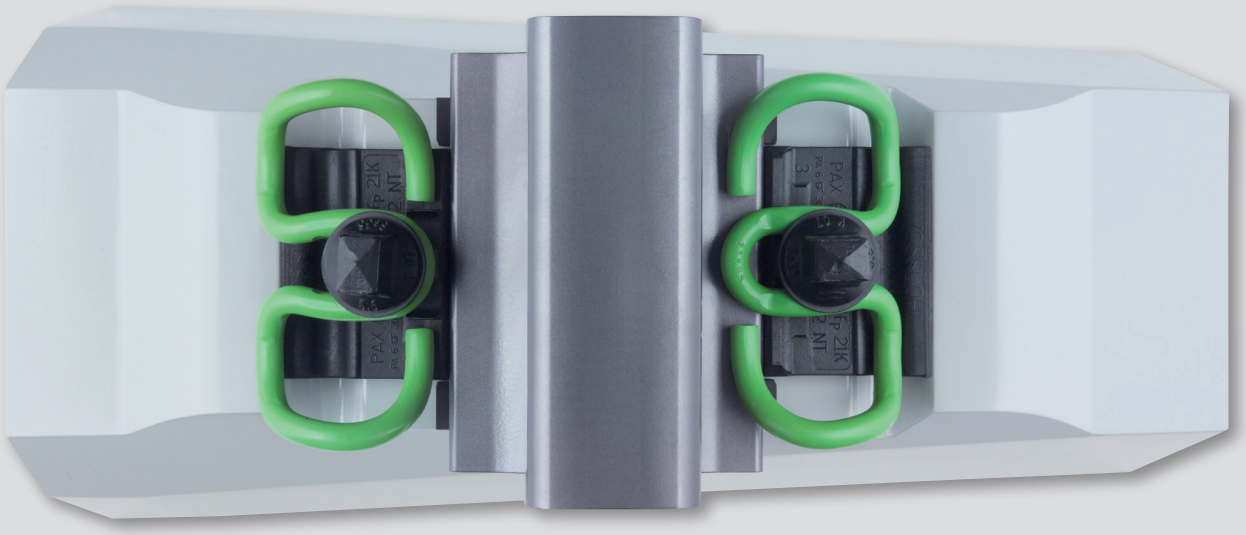
North America



System W 21

Highly elastic rail fastening for high speed and conventional rail –
the modern solution for ballasted track with concrete sleeper

Vossloh Fastening Systems

Based on our experience we are setting standards of the future.

High Speed on an elastic base

High speed means high dynamic forces – a test of stamina for the rail fastening system. Vossloh tension clamps for high speed traffic with more than 250 km/h (155 mph) ensure safe tensioning. Highly elastic components compensate acting forces in an outstanding way.

Conventional Rail – Safety on standard routes

Safety and comfort are decisive for rail traffic. Our tension clamps provide a stable fastening solution for types of track with a permissible axle load of up to 26 tonnes (29 tons). The highly elastic components additionally ensure a comfortable journey.

System W 21 – modern solution for concrete sleepers on ballasted tracks

The combination of concrete sleepers on ballast is the most frequently used railway track structure all over the world. In the so-called W-track, sleeper shoulders provide stability for track and fastening system and allow the transfer of forces generated by traffic. The ballast bed is flexible and transfers these loads homogeneously into the substructure. Furthermore, it absorbs noise and vibration caused by rolling trains. The W 21 system completes this railway track perfectly because its elastomer rail pad made of *cellentic* optimizes the elasticity and with this, it contributes to the protection of the track bed.

The all-rounder developed by the engineers of the W-fastening system

The W 21 system for conventional rail offers the same elasticity than the already approved W 14. However, the tension clamp Skl 21 with its fatigue strength of 2.5 mm and a deflection of 14.5 mm performs clearly more than the Skl 14. For this purpose, Vossloh has reinforced the Skl 21 by a thicker wire diameter. Due to the improved characteristics of the Skl 21, a highly elastic rail pad can be added in the W 21 HS («High Speed») system: Perfect requirements for the load transfer in high speed tracks.

The W 21 system becomes increasingly popular and since 2008 it has been being used in 30 countries on a total of about 3.000 km (1.900 miles), for instance in Argentina, Algeria, Azerbaijan, Bulgaria, Czech Republic, Finland, Germany, Kyrgyzstan, Lithuania and Slovakia.

cellentic

cellentic is an elastomer made of EPDM that ensures high stability against many types of chemical attacks. The advantage: the material provides excellent resistance to temperature, aging, and weather conditions as well as it is very stable under permanent load. Components made of *cellentic* optimize the elasticity for a reduction of vibrations and the protection of track.

System W 21

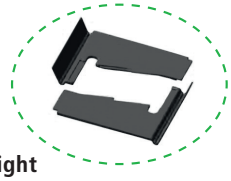
Elastic. Safe. Resilient. Flexible.

The W-shape of the Skl 21 provides safety

For meeting the required *rail creep resistance* two highly elastic, independently acting spring arms steadily hold the rail down; the middle bend acts as an additional *tilting protection*. With its high fatigue strength, it resists the dynamic vertical movements that are caused when the vehicle rolls over the rail. The system is *maintenance-free*: Due to the permanently acting tension, Skl and screw cannot loosen, the middle bend prevents the spring arms from plastic deformation.

Angled guide plates keep the rail in the track

The angled guide plates lead the forces introduced into the rail by train in the concrete. In this way, the screw-dowel combinations are not loaded by shearing and bending forces. The design of the angled guide plates additionally supports the *tilting protection*. Different widths can *regulate the gauge.*



Adjustable height

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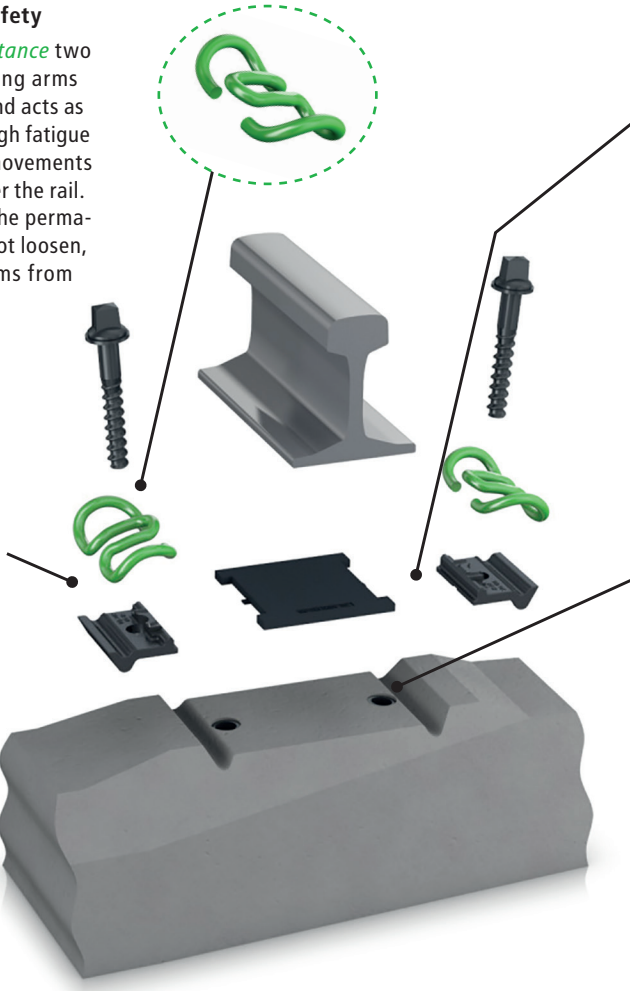

***cellentic* rail pad for high elasticity**

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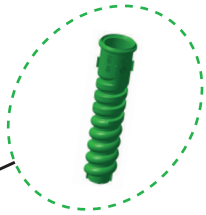

Securely clamped with the screw-dowel combination *NG*

The high-quality dowels made of high-tech material are extremely loadable and efficient: Lateral forces are reduced, this leads to a *decrease in the load on the sleeper.*

Easy handling for installation and rail maintenance due to preassembly and exchangeability

- All fastening components can be preassembled in the sleeper factory.
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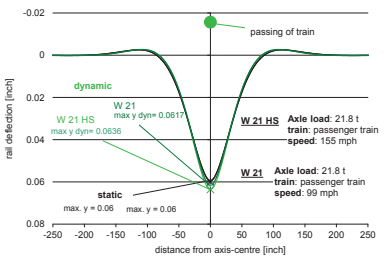
Safety. Comfort. Track protection.

Travel comfort through optimum rail deflection

The railway track must be elastic to compensate forces caused by running trains. The highly elastic *cellentic* components of the fastening system take over this job in addition to the ballast. The W 21 system with *cellentic* rail pad allows rail deflection and can optimally distribute occurring vertical forces. The result: Protection of track. Its elasticity is adapted to the traffic load to achieve optimum rail deflection: load distribution is at the maximum without overloading the rail. Furthermore, the *cellentic* component damps the vibrations caused by the unevenness of the track and the wheels; structure-borne track vibration is minimized. The result: high travel comfort, high safety through smooth running, as well as long lifetime of track components and vehicles.

Zimmermann computation



Simplified demonstration: one axle of a two axle bogie

Creep resistance and rail tilting protection

To allow optimum deflection for the rail, its fastening must respond in an elastic way. Therefore, the Skl 21 has a long spring deflection: When force is applied by a train, its spring arms remain in contact with the rail foot in each situation, also when the rail deflects. For this purpose, the rail is continuously clamped in a force-fitted way by the two spring arms with a deflection of approx. 14.5 mm (0.6 in) and a toe load of approx. 10 kN (2.3 kip). With this, also a high creep resistance is achieved: When the trains accelerate / decelerate, the rails remain in position, dangerous open fracture gaps due to broken rails are avoided. Simultaneously, a small gap between the middle bend and the rail foot of the rail has exactly the play required for operation. If the rail tilts excessively, e.g. in narrow curves, high forces are applied to the tension clamp. The Skl 21 is able to resist them: Rail movements are limited by the middle bend after the gap has been overcome, and the spring arms are not overstretched.

Load-deflection-curve

Rail fastening system W 21 with tension clamp Skl 21		
Typical field of application	High speed / Conventional rail; ballasted track with concrete sleepers	
Axle load	≤ 26 tonnes (29 tons)	
Speed	For HS: ≥ 250 km/h (155 mph) // for CR: 250 km/h (155 mph)	
Curve radius	For HS: ≥ 400 m (1,300 ft or 4°) // for CR: ≥ 150 m (500 ft or 12°)	
Height adjustment	optional	
Gauge adjustment	± 10 mm (0.4 in)	
Vertical fatigue strength of Skl 21	2.5 mm (0.10 in)	
Static stiffness of *cellentic* rail pad	≥ 30 kN/mm (170 kip/in)	EN 13146-9:2011
Relation of dyn. / stat. stiffness of *cellentic* rail pad	1.1	EN 13146-9:2011
Toe load of Skl 21 (nominal)	10 kN (2.25 kip)	EN 13146-7: 2012
Electrical resistance	≥ 5 kΩ	EN 13146-5: 2003
Rail creep resistance	≥ 9 kN (2 kip)	EN 13146-1: 2012
System approval / homologation		EN 13481-2: 2012

Remark

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System W 30 HH

Elastic rail fastening for heavy haul –
the resistant solution for ballasted track with concrete tie

vossloh
North America

System W 30 HH

Elastic rail fastening for heavy haul –
the resistant solution for ballasted track with concrete tie

Vossloh Fastening Systems

Based on our experience we are setting standards of the future.

Heavy Haul – Heavy loads are led safely

Axle loads of more than 26 tonnes (29 tons) mean extreme loads for the track. Resistant fastening systems provide for safe and durable connections and simultaneously allow fast and easy maintenance.

System W 30 HH – resistant solution for concrete ties on ballasted tracks

The combination of concrete ties on ballast is the most frequently used railway track structure all over the world. In the so-called W-track, tie shoulders provide stability for track and fastening system and allow the transfer of forces generated by traffic. The ballast bed is flexible and transfers these loads homogeneously into the substructure. Furthermore, it absorbs noise and vibration caused by rolling stocks. The W 30 HH system perfectly completes this to form an optimum railway track for the heavy haul traffic.

Rising to the challenges of heavy haul tracks ...

The W 30 HH system is designed for high axle loads of up to 35 tonnes (39 tons). It combines all approved advantages of the W-system family with those of the tension clamp Skl 30: It has a greater diameter and optimized geometry to provide high toe loads, high dynamic fatigue strength and a high creep resistance. This allows safe travelling also under extreme conditions at temperatures of – 76 to + 122 degrees Fahrenheit. Additionally, rail pad, angled guide plate and screwed dowel made of plastics act electrically insulating – an additional insulator between Skl and rail is not required.

... and of tracks for mixed traffic

By the use of a more elastic railpad 160 kN (36 kip), the W 30 HH is also suitable for tracks that serve both heavy haul and passenger traffic. For instance in the United Arabic Emirates: Here, freight trains with an axle load of 32,5 tonnes (36 tons) run at a speed of 120 km/h (75 mph), while passenger trains (axle load 25 tonnes (28 tons)) reach speeds up to 200 km/h (125 mph).

The W 30 HH AP system includes an additional abrasion plate (AP) that sits between rail seat and rail pad to protect both. The plate made of glass-fibre reinforced polyamide is abrasion-resistant and can be loaded with high contact pressure. Its special design avoids penetration of sand: Performed tests on constant load – in compliance with the US-directive AREMA chapter 30 – at changing temperatures and using a sand-water mixture have verified it.
Up to now, the W 30 HH system has been installed on approx. 700 km (435 miles) heavy haul tracks, among others in the desert of the United Arabic Emirates and the USA.

System W 30 HH

Elastic. Safe. Resilient. Flexible.

The W-shape of the Skl 30 provides safety

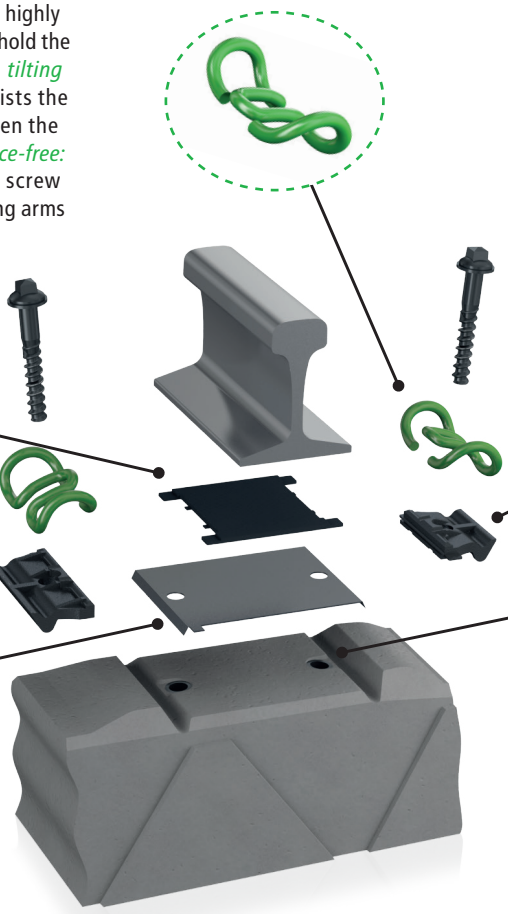
For meeting the required *rail creep resistance* two highly elastic, independently acting spring arms steadily hold the rail down; the middle bend acts as an additional *tilting protection*. With its high fatigue strength, it resists the dynamic vertical movements that are caused when the vehicle rolls over the rail. The system is *maintenance-free:* Due to the permanently acting tension, Skl and screw cannot loosen, the middle bend prevents the spring arms from plastic deformation.

Rail pads of TPU resist high axle loads

The *resistive* material and the special *heavy haul design* of the rail pad make sure that the system withstands the high pressure of the traffic loads.

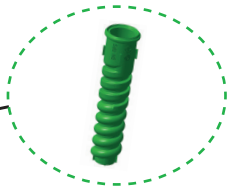
Less abrasion – higher durability

Abrasion Plate protects rail seat and rail pad *and impedes the penetration of sand.*



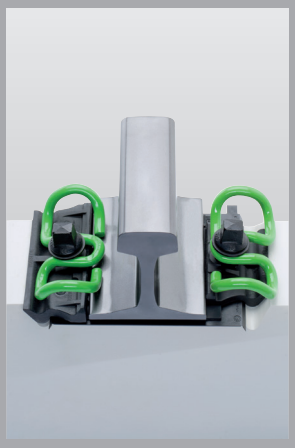
Angled guide plates keep the rail in the track

The angled guide plates lead the forces introduced into the rail by train in the concrete. In this way, the screw-dowel combinations are not loaded by shearing and bending forces. If high lateral forces apply, *trapezoid*, *angled guide plates* can be used to deflect these forces via a larger contact face. The design of the angled guide plates additionally supports the *tilting protection*. Different widths can *regulate the gauge.*



Securely clamped with the screw-dowel combination *NG*

The high-quality dowels made of high-tech material are extremely loadable and efficient: Lateral forces are reduced, this leads to a *decrease in the load on the tie.*



Easy handling for installation and rail maintenance due to preassembly and exchangeability

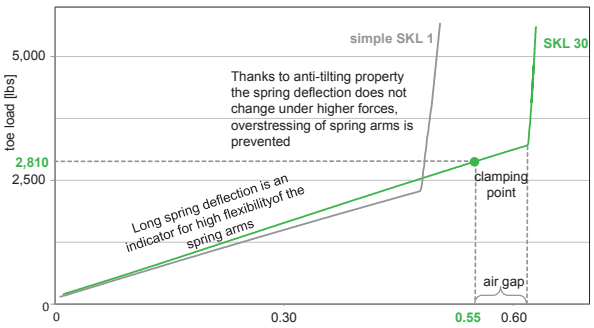
- All fastening components can be preassembled in the tie factory.
- At the construction site, it will only be required to lay the rail and clamp it. That way, fastening components cannot get lost.
- Due to the innovative tool VosMat Rapid, an automated installation of the system is possible.
- For welding of the rail, no fastening elements have to be removed from the support point.
- All components, including dowels, can be replaced easily. Replacement of ties can be avoided.

Safety. Comfort. Track protection.

Creep resistance and rail tilting protection

To allow optimum deflection for the rail, its fastening must response in an elastic way. Therefore, the Skl 30 has a long spring deflection: When forces are applied by a train, its spring arms remain in contact with the rail foot in each situation. For this purpose, the rail is continuously clamped in a force-fitted way by the two spring arms with a spring deflection of approx. 14 mm (0.55 in) and a toe load force of approx. 12.5 kN (2.8 kip). With this, also a high creep resistance is achieved: When the trains accelerate / decelerate, the rails remain in position, dangerous open fracture gaps due to broken rails are avoided. Simultaneously, a small gap between the middle bend and the rail foot of the rail has exactly the clearance required for operation. If the rail tilts excessively, e.g. in narrow curves, high forces are applied to the tension clamp. The Skl 30 is able to resist them: Rail movements are limited by the middle bend after the gap has been overcome, and the spring arms are not overstretched.

Load-deflection-curve



Rail fastening system W 30 HH with tension clamp Skl 30		
Typical field of application	Heavy Haul; ballasted track with concrete ties	
Axle load	≤ 35 tonnes (39 tons)	
Speed	≤ 160 km/h (100 mph)	
Curve radius	≥ 400 m (1300 ft or 4°)	
Height adjustment	optional	
Gauge adjustment	± 10 mm (0.4 in)	
Vertical fatigue strength of Skl 30	2.2 mm (0.09 in)	
Static stiffness of rail pad	≥ 400 kN/mm (2.300 kip/in)	EN 13146-9:2011
Toe load of Skl 30 (nominal)	12.5 kN (2.8 in)	EN 13146-7: 2012
Electrical resistance	≥ 5 kΩ	EN 13146-5: 2003
Rail creep resistance	≥ 9 kN (2 kip)	EN 13146-1: 2012
System approval / homologation		EN 13481-2: 2012 AREMA Chap. 30

Remark

Contents, figures and technical data in this brochure display exemplarily the performance of the fastening system, however, they always depend on external conditions. Please contact us to enable us to develop a solution for you that will be customized to your requirements. The information presented corresponds to the technical state at the time of printing; in the meantime, continuous research and development programmes at Vossloh could have caused adaptations of the product.

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www.vossloh-north-america.com

Vossloh Fastening Systems
America Corporation
233 South Wacker Drive, Suite 9730
Chicago, IL 60606, USA

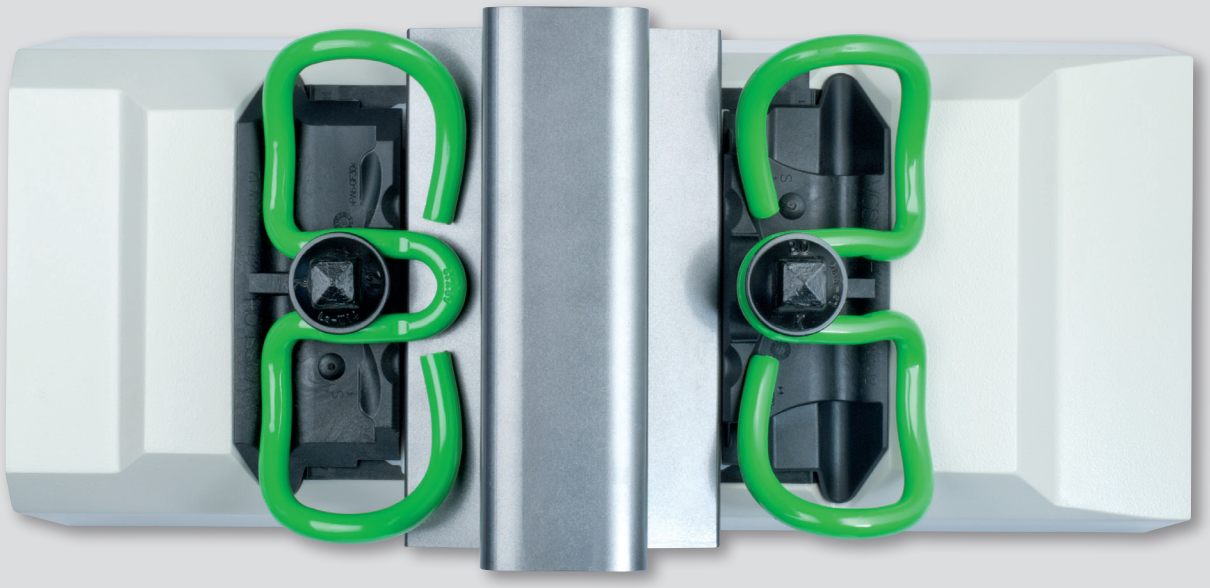
Phone 312.376.3200
Fax 312.376.3252
E-Mail info@vossloh-usa.com

vossloh
North America

System W 40 HH

Elastic rail fastening for heavy haul –
the durable solution for ballasted track with concrete sleeper

vossloh
North America



System W 40 HH

Elastic rail fastening for heavy haul –
the durable solution for ballasted track with concrete sleeper

Vossloh Fastening Systems

Based on our experience we are setting standards of the future.

Heavy Haul – Heavy loads are led safely

Axle load of more than 26 tonnes (29 tons) means extreme loads for the track. Resistant fastening systems provide for safe and durable connections and simultaneously allow fast and easy maintenance.

W 40 HH – the durable solution for concrete sleepers on ballasted tracks

The combination of concrete sleepers on ballast is the most frequently used railway track structure all over the world. In the so-called W-track, sleeper shoulders provide stability for track and fastening system and allow the transfer of forces generated by traffic. The ballast bed, however, is flexible and transfers these loads homogeneously into the substructure. Furthermore, it absorbs noise and vibration caused by rolling trains. The W 40 HH system perfectly completes this to form an optimum railway track for the heavy haul traffic.

Rising to the challenges of heavy haul tracks

The W 40 HH is especially designed for extreme mechanical loads on heavy haul tracks and there, it is mainly used in narrow bends: Wider angled guide plates on the field side allow a higher load input; the tension clamp Skl 40 whose spring arms are bent backwards guarantees safe contact to the rail foot due to its newly designed shape.

Besides the high toe load improves the lateral and vertical holding forces while in the same time high fatigue limits provide for a long service life and with this, for low lifetime-costs.

The W 40 HH AP system includes an additional abrasion plate (AP) that sits between the rail seat and the rail pad to protect both of them. The plate made of glass-fibre reinforced polyamide is abrasion-resistant and can be loaded with high contact pressure. In addition, its special design avoids penetration of sand. Performed tests on constant load – in compliance with the instructions in the US-directive AREMA chapter 30 – at changing temperatures and using a sand-water mixture have verified it.

W 40 HH has approved to be successful since its introduction on the heavy haul tracks in the USA in 2013. They have been installed there already on approx. 300 km (200 miles).

System W 40 HH

Elastic. Safe. Resilient. Flexible.

The innovative shape of the tension clamp Skl 40 provides safety and durability

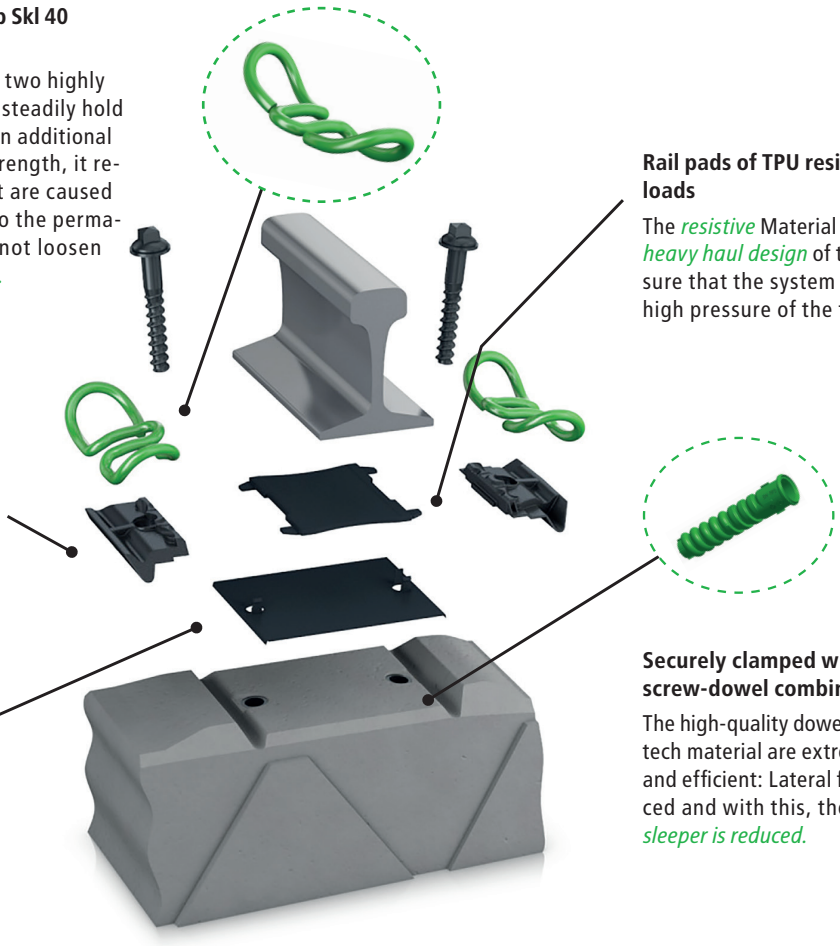
For meeting the required *creep resistance* two highly elastic, independently acting spring arms steadily hold the rail down; the middle bend is used as an additional *tilting protection*. With its high fatigue strength, it resists the dynamic vertical movements that are caused when the vehicle rolls over the rail. Due to the permanently acting tension, Skl and screw cannot loosen and therefore, they are *maintenance-free.*

Angled guide plates keep the rail in the track

The angled guide plates lead the forces introduced into the rail by train in the concrete. In this way, the screw-dowel combinations are not loaded by shearing and bending forces. *Wider angled guide plates on the field side* allow the input of higher loads, especially at extreme mechanical loads in bend areas. The design of the angled guide plates additionally supports the *tilting protection*. Different widths can *regulate the gauge.*

Less abrasion – higher durability

Abrasion Plate protects rail seat and rail pad *and impedes the penetration of sand.*

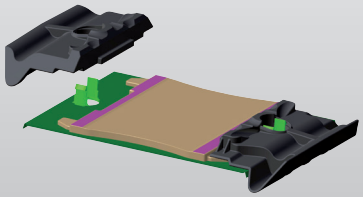


Rail pads of TPU resist high axle loads

The *resistive* Material and the special *heavy haul design* of the rail pad make sure that the system withstands the high pressure of the traffic loads.

Securely clamped with the screw-dowel combination *NG*

The high-quality dowels made of high-tech material are extremely loadable and efficient: Lateral forces are reduced and with this, the *load on the sleeper is reduced.*



Easy handling for installation and rail maintenance due to preassembly and exchangeability

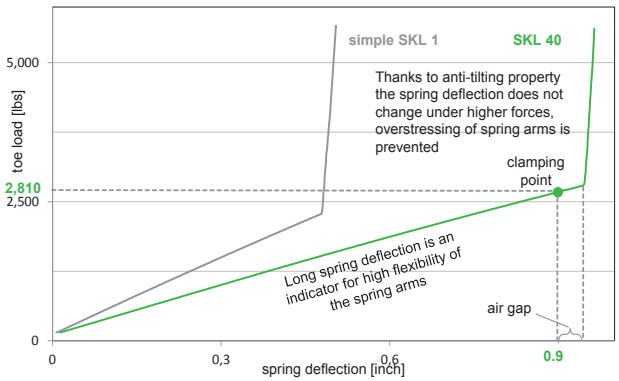
- All fastening components can be preassembled in the sleeper factory.
- At the construction site, it will only be required to lay the rail and clamp it. In this way, fastening components cannot get lost.
- Due to the innovative tool VosMat Rapid, an automated installation of the System is possible.
- For welding of the rail, no fastening elements have to be removed from the sleeper.
- All components, including dowels, can be replaced easily. Replacement of sleepers can be avoided.
- Optional preassembly of rail pad and angled guide plates on the abrasion plate for easy replacement in the track (Rail-Relay).

Safety. Comfort. Track protection.

Creep resistance and rail tilting protection

To allow optimum deflection for the rail, its fastening must respond in an elastic way. Therefore, the Skl 40 has a long spring deflection: When forces are applied by a train, its spring arms remain in contact with the rail foot in each situation. For this purpose, the rail is continuously clamped in a force-fitted way by the two spring arms with a spring deflection of approx. 23 mm (0.9 in) and a toe load of approx. 12.5 kN (2.8 kip). With this, also a high creep resistance is achieved: When the trains accelerate/decelerate, the rails remain in position, dangerous open fracture gaps due to broken rails are avoided. Simultaneously, a small gap between the middle bend and the rail foot of the rail has exactly the play required for operation. If the rail tilts excessively, e.g. in narrow bends, high forces are applied to the tension clamp. The Skl 40 is able to resist them: Rail movements are compensated by the middle bend after the gap has been overcome, and the spring arms are not overstretched.

Load-deflection-curve



Rail fastening system W 40 H with tension clamp Skl 40		
Typical field of application	Heavy haul; ballasted track with concrete sleepers	
Axle load	≤ 35 tonnes (39 tons)	
Speed	≤ 160 km/h (100 mph)	
Curve radius	≥ 150 m (500 ft or 12°)	
Height adjustment	optional	
Gauge adjustment	± 10 mm (0.4 in)	
Vertical fatigue strength of Skl 40	3.2 mm (0.13 in)	
Static stiffness of rail pad	≥ 400 kN/mm (2,300 kip/in)	EN 13146-9:2011
Toe load of Skl 40 (nominal)	12.5 kN (2.8 kip)	EN 13146-7: 2012
Electrical resistance	≥ 5 kΩ	EN 13146-5: 2003
Rail creep resistance	≥ 9 kN (2 kip)	EN 13146-1: 2012
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www.vossloh-north-america.com

Vossloh Fastening Systems
America Corporation
233 South Wacker Drive, Suite 9730
Chicago, IL 60606, USA

Phone 312.376.3200
Fax 312.376.3252
E-Mail info@vossloh-usa.com