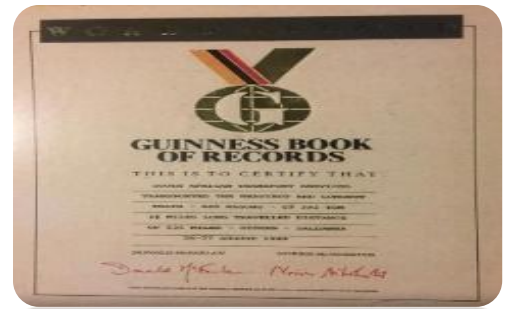


GLOBAL RAILWAY ENGINEERING

SCHEFFEL

BA



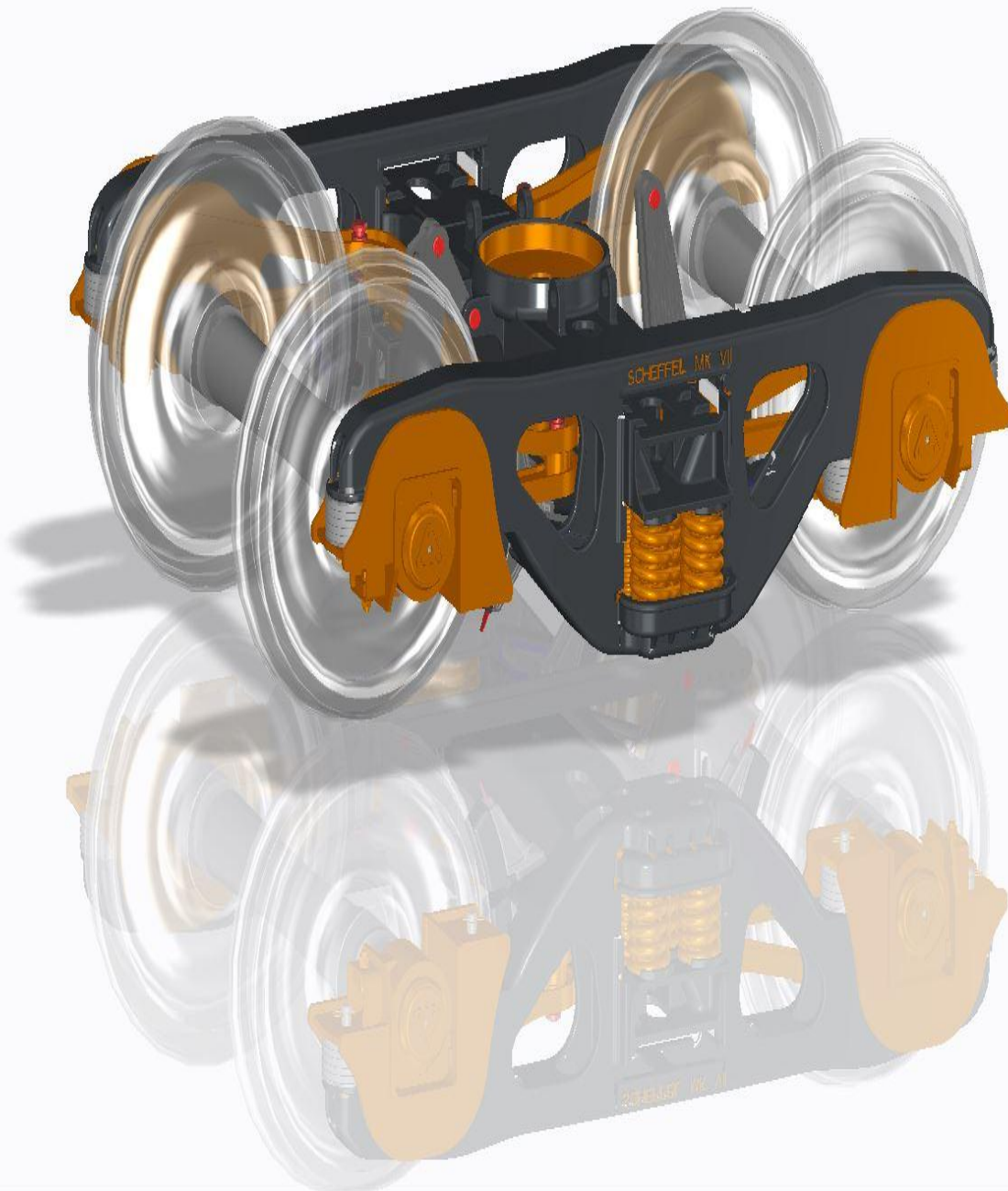
*WORLD RECORD HOLDER

SCHEFFEL BOGIES

Axle Load Capacity 16.5t-37.5t

Gauges: 1000mm-1676mm

Product Overview



HS SCHEFFEL SELF STEERING BOGIES

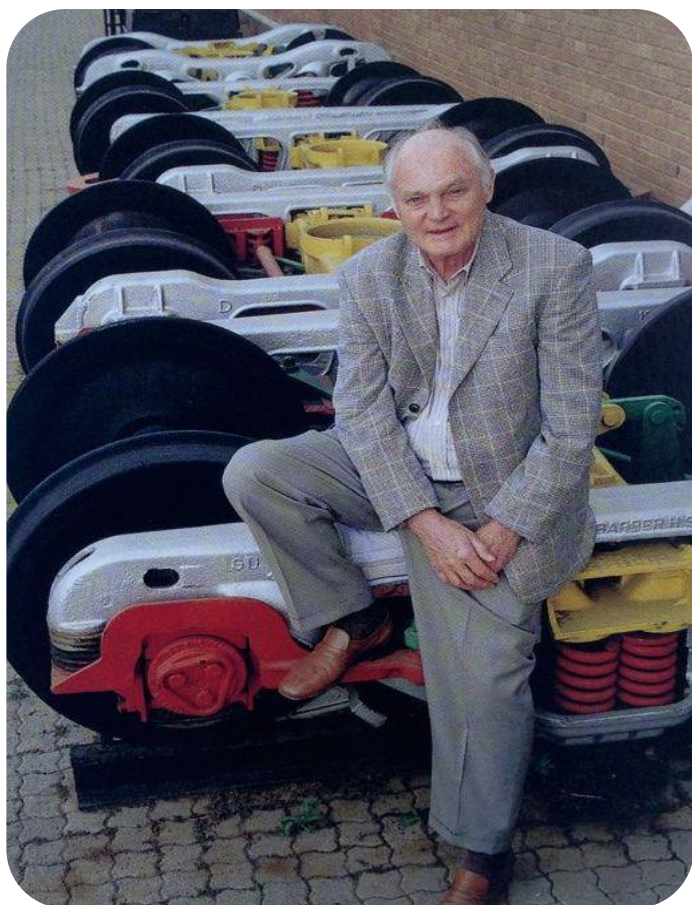
A Legacy of Leadership in Freight Bogie Technology

In the 1970s, Dr. Herbert Scheffel (HS) revolutionized the freight rail industry with a groundbreaking bogie design that would change the face of heavy-haul rail transport forever. His invention — the **Scheffel Self-Steering Bogie** — set new global benchmarks for performance, efficiency, and reliability in rail freight systems.

Developed through decades of pioneering work in self-steering technology, the Scheffel Bogie is the result of a visionary collaboration between **Dr. Herbert Scheffel** and **Mr. Rowlen von Gericke**. Together, they introduced innovations that redefined engineering standards and elevated the capabilities of freight bogies to world-leading levels — including contributing to record-breaking rail performance achievements.

Today, **Global Railway Engineering (GRE)**, headquartered in South Africa, holds the **exclusive global intellectual property rights and trademarks** for the Scheffel Bogie technology. GRE is the sole custodian of this advanced self-steering bogie system and is actively driving its application across a wide range of railway environments — from the harsh operating conditions of Southern Africa to high-capacity freight corridors worldwide.

With full design, manufacturing, and support capabilities, GRE ensures that Scheffel Bogies deliver consistent, top-tier performance under axle loads ranging from **16 to 37.5 tonnes in all gauges**. Supported by a global field service network, GRE is committed to maintaining the exceptional reliability and cost-efficiency that the Scheffel brand has come to represent in the world of freight rail.



Building on a Legacy of Proven Success

Advantages that Set Scheffel Bogies Apart

Scheffel Self-Steering Bogies are engineered to deliver unparalleled results in heavy-haul rail operations, offering:

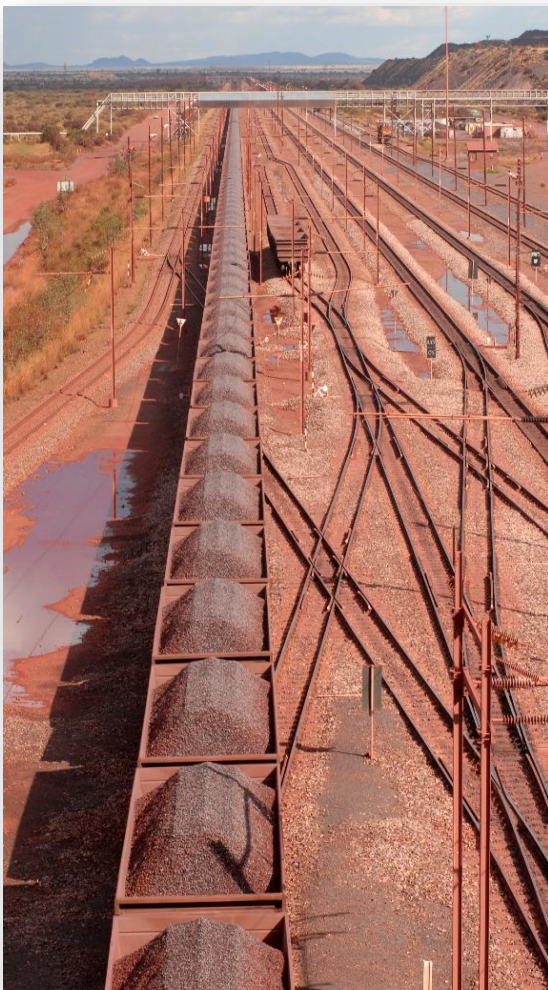
- **Enhanced Productivity:** Higher axle loads and increased wagon availability.
- **Superior Cost Efficiency:** The lowest cost per ton transported, maximizing operational value.
- **Exceptional Reliability:** Greater train control and consistency, ensuring safe and efficient operations.
- **Unmatched Performance:** Outperforming other freight bogies in its class in terms of stability, comfort, and operational longevity.

The Industry Standard for Heavy-Haul Rail

Whether transporting minerals, goods, or other heavy loads, the Scheffel Self-Steering Bogie stands as the ultimate choice for ultra-class loading and demanding railway operations. Its proven design ensures productivity, safety, and reliability, solidifying its position as the gold standard in Self Steering freight bogie technology.

Driving the Future of Freight Rail

Global Railway Engineering remains committed to pushing the boundaries of rail performance. With the Scheffel Bogie, operators can achieve world-class efficiency and reliability, meeting the evolving needs of modern railway networks in today's demanding railway operations.



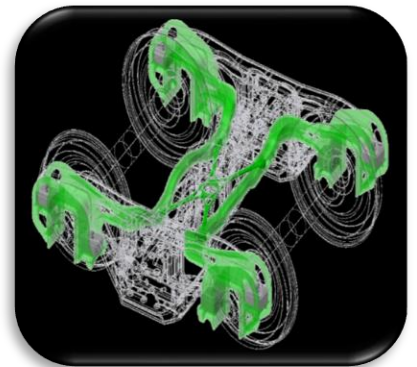
Scheffel Bogies proven performance is unmatched

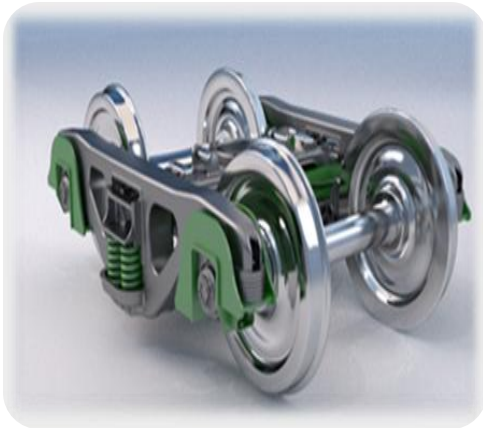
Scheffel Self Steering Bogies have been exceeding customer requirements and expectations since 1970's:

- Up to 25x times lower rail wear
- Up to 16x times lower wheel wear
- Up to 10% lower fuel savings
- Up to 50% faster cycle times
- Up to 98.5% availability on wagons
- Up to 50% increase in operational productivity
- 8-10% higher axle load on existing rail

Providing our customers:

- Lowest total cost of ownership (LTCO)
- World Class Life Cycle Cost (LCC)
- Higher operational productivity of rolling stock
- Lower locomotive tractive efforts in curves (due to free rolling of wheels in curves)
- Lower fuel use which creates less refueling times for Locomotives
- Excellent wheel reliability and durability up to 5 million kilometers (depending of line)
- Excellent rail reliability and durability on Rail savings, rail lines see up to 3 billion tons transported in curves plus (Transnet SA) which is still in use





Scheffel setting the standard for Freight Bogies Worldwide

The Scheffel Bogie features:

- True self steering technology, Zero flange wear.
- Zero lateral flange forces, hunting stability.
- Proven World Record technology for everyday hauling.
- Proven world class heavy haul capabilities.



ESTABLISHED 1956
GLOBAL
GROUP OF COMPANIES

The Scheffel Self-Steering Bogie

and greenest

One of the world's most advanced bogies

- ✓ The Scheffel Self Steering Bogie... **Efficient, Reliable, Proven Savings**
- ✓ World's first **green bogie**

Worlds first truly Green Bogie

- ✓ Each wagon converted from conventional to Scheffel can potentially create the same carbon offset as planting some 2000 trees.
- ✓ Contribute to a sustainable future - Have your rail transport offset your carbon footprint.
- ✓ Drastically reduce your carbon emission taxes on transport

- ✓ a minimum savings of **5 times less maintenance...** despite having more components
- ✓ In South Africa, one coal-line operating on Scheffel Self-Steering technology is estimated to have offset the same amount of CO₂ as planting some 15,000,000 trees.
- ✓ Utilising Scheffel Self-Steering bogies mean less overall rolling resistance this means and greater fuel efficiency for a greener planet.

Can reduce rail transport OPEX by up to 68%

- ✓ No flange wear
- ✓ No rail side wear
- ✓ Minimal wheel tread wear
- ✓ Lower rolling resistance
- ✓ Lower derailment factor
- ✓ Higher stability and softer ride
- ✓ Reduced turn around time

Drastically reduces rail CAPEX

- ✓ Increased axle load
- ✓ Increased wagon load
- ✓ Thinner and lighter wheel tread
- ✓ Reduced overall fleet size

Payback Model Showing Financial Advantage of Scheffel Bogie over Standard 3-Piece Bogie

Scheffel vs Spoorbarber bogies on a typical heavy haul line. Please speak to one of our engineers to estimate savings on your line.

Scheffel wheel profile after 75 000km

3-piece wheel profile after 75 000km

Global Companies

Global House, 60 Tulbach Road, Kempton Park, Gauteng, South Africa | P.O. Box 10285, Aston Manor, 1630

Scheffel Bogies = Performance Edge

Bogie of choice for the world's toughest Rail applications

- Steering Capability – Allow Higher Speeds under lower hunting conditions giving the Bogie a very high degree of Speed potential, which increases faster cycle times, higher productivity.
- Having Zero Flange Contact allows a lower Wheel Angle of Attack which lowers the Forces in the Wheel. Giving lower Wheel Wear in curves.
- Less Wheel Wear equals Less Wheel maintenance, resulting in higher Wagon availability which results in Wagons having higher wagon performance.
- 98.5% Wagon availability achieved on the Iron Ore Line between Sishen – Saldanha in South Africa.

Technology

- Development of thousands of tests generated over 50 years brings together Superior performance, monitoring and data integration capabilities.
- Lowering Maintenance equals less wagons in fleet.

Maintenance Friendly

Performance and comfort have been optimized with:

- Smart ergonomics
- Clear Maintenance Principals
- Easily integrated Wheel management brings forward an in command and lowering replacement functions.
- Reducing Wheel cutting is key to Wheel health and increase the performance provided by lowering mistakes made when Wheel cutting is done as well as allowing axles to be damaged or scraped, results in huge saving and maintenance controls over 30-40 years life cycle of bogies.

Smart Solutions

Our SMART Sub Frames systems, advanced cross anchor system are integrated together and customized to solve our customers' toughest challenges:

- Lower Service products and consumables
- Lower Bogie rebuilds
- Lower Component exchange programs
- Lower Life Cycle Cost & management
- Genuine OEM parts
- Lower Prognostics

Scheffel Bogies are the worldwide leaders in Heavy Haul Rail - Used on Longest Commercial Trains.

The Scheffel Bogies sets the standard in performance and productivity.

- Designed for *severe operations under severe conditions.*
- Years of experience in building rugged, reliable bogies for heavy haul or long trains.
- Extensive collaboration with customers and our partner Dr. Scheffel during development.

We are driven by achieving the lowest total cost of ownership for our customers:

- Quality components
- Focus on machine availability



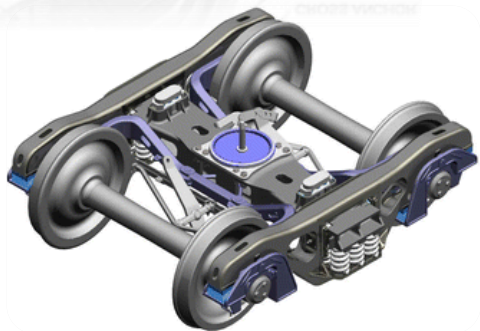
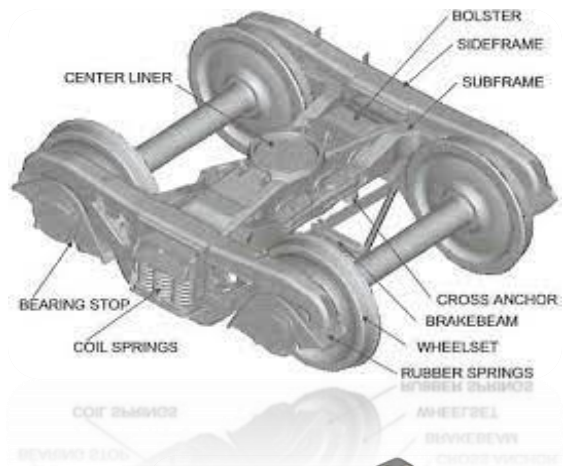
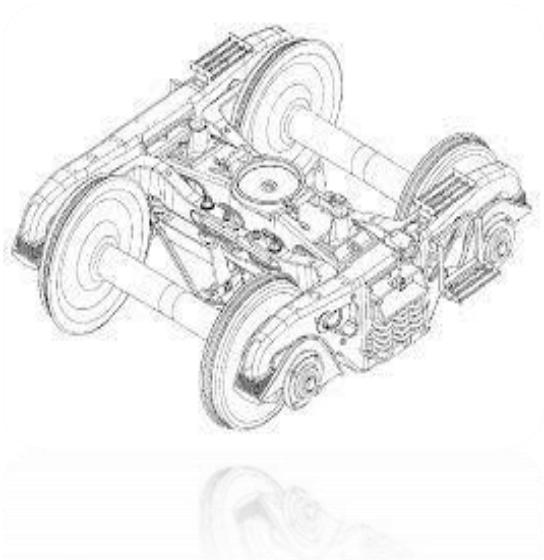
Scheffel Bogies for all Gauges in the world



Rail Gauges for Scheffel Bogies

North America	1435mm
South America	1000mm
	1435mm
	1600mm
Africa	1000mm
	1067mm
	1435mm
Middel East - Eurasia	1435mm
	1525mm
Asia	1000mm
	1435mm
	1525mm
India	1676mm

Capacity	MKVII Class	MKV Class
Nominal payload*	18.5t - 21.5t	26t - 37.5t
Normal Wheel Dia	864mm-915mm	864mm-915mm
Rated Bearing Loads	Class C-Class D	Class E - Class G
Operational Speed Rating	120km/h	120km/h



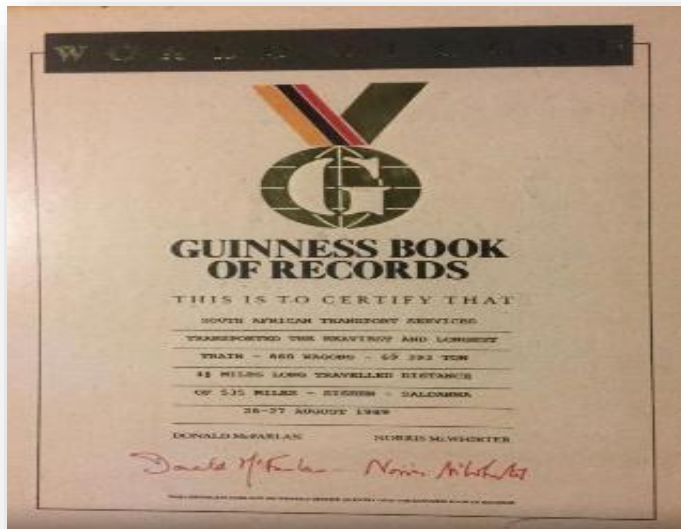
Scheffel Bogies – Guinness World Records

Longest Train - Guinness World Record 660 Wagons

1989 World Record	Longest Train over Longest Distance traveled 861km
Number of Wagons	660 Wagons
Number of Locomotives	16 Locomotives

Length of Train 7 500m or 7,5km

Guinness World Record 1989



Lower In-Train Forces

Having Steering ability allows the operator to experience lower in-train forces, which results in lower maintenance of Rail Wagons, Lower Wear on Locomotive Engines as well as Lower Fuel use. Locomotives experience less resistance in curves when hauling trains with Scheffel Bogies.

Lowering in-train forces in Trains brings forth the advantage of increasing train lengths as Couplers has a maximum of 160kn force which can easily break couplers or detach trains if forces are high and exorbitant.

Having peace of mind when forces are lower, generates very little chances of couplers break in remote regions which is not easily accessible for maintenance teams to replace.

Longer Trains with Self Steering

Having Self Steering ability in Bogies, allows for very low forces which generates the ability to build longer trains. When running longer trains, operational management lowers your cost for the total number of wagons and locomotives, as well as operational personnel. Long trains give operators the ability to off-load large volumes of products in a shorter time, lowering stockpile time and increase shipping output. Ports get more ships loaded in shorter times as Port Output increases with 50% plus.

Sub Frame Adaptors

Two Sub-Frame adaptors have been designed and developed to connect one wheel with the other wheel diagonally across with the help of cross anchors.

Lower Locomotive Tractive Power - Fuel Economy

Fuel Cost is the largest contribution to cost for any Railways, which means Fuel burn is a large concern for Railways and many fuel saving devices have been designed and developed over 50-100 years. No product can say they can without a doubt save vast amounts of fuel, well Scheffel Bogies can, seeing the wheels take a radial position, creating zero flange forces. Locomotives pull wagons easier with Scheffel Bogies allowing a very serious fuel saving depending on the line, in curvy rail the saving can be as much as 10%-12%.

Wheel Savings

Wheels of 3 Piece Bogies experience severe Wheel Wear due to 3 Piece Bogies not able to steer, which increase the Angle of Attack between wheel and rail in curves. This high angle of attack generates excessive wear on the flanges which results in high flange wear limiting wheel life. Wheels in Scheffel Bogies can last up to 16 times longer than those on 3 Piece Bogies.

Rail Savings

Rails in curves experience high wear ratio's due to Wheel flanges attacking the Rail thus causing the Rail to wear out, 3 Piece bogies increase the wear rate and in South Africa outer rails in curves are replaced at every 70mt being railed. When Scheffel Bogies started to be used, the outer rails in curves were still in place after 3 billion tons railed, this is a massive saving of x 42 times. This is without a doubt one of the most critical factors for operators, as this also generate higher safety factors.

Higher Speeds - Guinness World Record 245km/h

Scheffel Bogies have a very high resistance to hunting, thus lowering hunting when increasing speed, this generates a higher stability and allows the ability to increase the operational speeds (permitting) when running Scheffel Bogies. Scheffel Bogies have been tested at 181km/h running stable, under roller rig conditions. In practice Scheffel Bogies has been tested to 160km/h running very stable, which cemented the testing of high speeds in South Africa and holds the Guinness World record running 245km/h on 1067mm gauge in South Africa.

Longest Commercial Trains in the world



South Africa - Manganese Ore Line	375 Wagons
South Africa - Iron Ore Line	342 Wagons
Brazil - Iron Ore Line	330 Wagons
Australia - Iron Ore Line	268 Wagons
China - Coal Line	210 Wagons



Around the World - Scheffel Bogies operating under -50 degrees to +60 degrees



Scheffel Bogies - Prove Zero Flange Wear after 75000km Testing in Brazil on 1600mm gauge

Advanced 3 piece competitor



75,000km

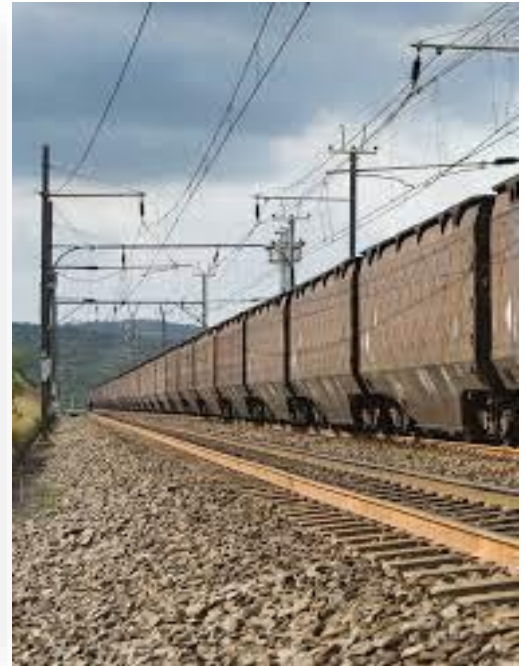
Noticeable wear evident on flange. Wear evident across whole wheel surface. Risk of flange related derailment.

Scheffel 1600 gauge truck



75,000km

Essentially no flange wear. Brake shoe contact patch polished. Rust evident on flange and outer wheel tread indicating minimal contact with rail during operation.



Scheffel Bogies - Proven - Zero Flange Wear @ 500 000km when comparison tests were done in 1993 between 3 Piece Bogies vs Scheffel Bogies on the Chrome Line in South Africa



Fig. 1. Wheel profile of a conventional iron ore wagon after 380000km, 60km/h and an axleload of 18.5 ton



Fig. 2. Wheel profile of a self-steering iron ore wagon after 500000km, 60km/h and an axleload of 18.5 ton

Acknowledgement:
Dr R D Fröhling "Strategies to control wheel profile wear"
Transwerk Freight Rail, South Africa (TFR)

Scheffel Bogie - Life Cycle Costs & Wheel & Wagon Savings

Life Cycle Costs 3 Piece Bogies vs Scheffel Bogies

	Avg 3 Piece Bogies	Scheffel Bogies
Standard: Avg Kilometer before machining a wheel	150 000km	300 000km
Avg machine cuts per Wheel	4x Cuts	16x Cuts
Avg life of Bogie Wheel in kilometers	600 000km	4 800 000km
If you run average 150 000km per year, then you will replace wheels every	4 years average	26 years average

Comparison of Wagons Required to Rail 1 000 000 tons

If you rail 1 000 000 tons per year the following assumptions could be made:

3 Piece Bogies	@	18.5 tons/Axle	160 Wagons	0%
Scheffel MkVII	@	20.0 tons/Axle	142 Wagons	12% reduction
Scheffel MKV	@	26.0 tons/Axle	103 Wagons	46% reduction

* All figures received via Transnet)

Cutting of Profile

3 Piece Bogies wear the flange area very quick due to the flange contacting the rail due to the high angle of attack.

To machine wheels, your workshop must be equipped with the best possible Wheel Lathe, which has to be calibrated on a regular basis. Reliability, and productivity over the lifecycle of the wheel cutting operation of wheels requires very high skilled staff

- Wagons are lifted off the Bogies, Bogies are then rolled to the area where the Wheels are taken out by lifting the Bogies off the Wheelsets.
- Wheelsets are then moved to the Wheel Lathe area where they are fitted into the wheel lathe by placing them in position after carefully measuring the wheel and data is then used to carefully measure each cut
- Wheel lathe operators need to make sure they are cutting the wheels within a specific tolerance
- Wheelsets are measured on a regular basis to ensure that the wheels are machines correctly
- After machining the wheels, the wheelsets are taken back to the assembly area where they are the following an assembly procedure to get them back into the bogies
- If wheels are to be replaced after their life, wheels are pressed off the axles and new wheels are then pressed back on, this procedure can easily damage axles.
- Axle damage can be as high as 20% of yearly axle replacement if wheels are to be changed every 4 years
- Wheels on Scheffel Bogies are only replaced after an average of 30 years which limited the axle damage by 7.5 times



50 years of achievement

True steering is not so easily achieved in Bogies, which is why Dr. Scheffel is the father of Self Steering in the world. In the early 1970's Dr. Scheffel was tasked to find solutions to high wheel wear as well as high rail wear on South African Railway lines and went out in the world to find existing technology which could be used to this cause. After many years of years of searching and testing bogies Dr. Scheffel came up with the belief that there is no solution available to really limit wheel wear and rail wear in bogies. This was the brainchild of Dr. Scheffel that a bogie can perform at higher degree when it can steer, which created the idea to develop a bogie which has steering abilities so that lower wheel and rail wear, could be achieved. This was the beginning of development and testing of thousands of hours to develop Scheffel Self Steering Bogies after 50 years to perfection.



Broken Wheels

Broken wheels could occur due to various material defects within the core of the wheel in the manufacturing process. This can not be detected early, and once this occurs, bogies normally derail immediately as the flange connects/hits against the rail, and the bogie with broken wheel derails the wagon. This could potentially derail many wagons which could create a huge derailment, for an operator with disastrous consequences for operations.

Here we see a Scheffel Bogie with a broken wheel, which has run without derailing, as the Wheel flange has never made contact with the rail head and therefore did not derail the wagon. This is again concrete proof that Scheffel Bogies do not derail due to flange derailment contact and perform under severe conditions even with a broken wheel.



+10% Increase in Axle Load without line upgrade

When Scheffel Bogies are run, the lateral forces in curves are lower than 3-piece bogies, and due to this, the South African Railways - Transnet has approved that on all lines in South Africa using 48kg/m lines (18.5t) capacity where Scheffel Bogies are used, the operations can add 10% higher axle loads due to the lower contact stresses are experiencing with Scheffel Bogies. This has a significant impact on lines where the axle load is limited to 18.5 tonnes so where Scheffel Bogies are used, the line capacity went up to 20t, which makes the Scheffel Bogie a true game changer for any railway lines in Africa where line capacity can be increased without having to upgrade the line.

Scheffel Bogies can bring operators an increase in "Axle Load" without needing to upgrade line capacity, due to 2 stage suspension system.

If you use Scheffel Bogies an increase of +-10% Axle Load could be achieved on existing rail lines without upgrading the line

16.5t Lines	@	1.65 tons/Axle increase	Increase to 18.15t/Axle	6.6t increase payload per Wagon
18.5t Lines	@	1.85 tons/Axle increase	Increase to 20.35t/Axle	7.4t increase payload per Wagon
20.0t Lines	@	2.0 tons/Axle increase	Increase to 22.00t/Axle	8t increase payload per Wagon
22.5t Lines	@	2.25 tons/Axle increase	Increase to 24.75t/Axle	9t increase payload per Wagon
25t Lines	@	2.5 tons/Axle increase	Increase to 27.50t/Axle	10t increase payload per Wagon

* All figures verifiable via Transnet Freight Rail - Track Technology Management)



TO WHOM IT MAY CONCERN

The Railways in South Africa (today called Transnet Freight Rail)(TFR) has, years back, traditionally used conventional non-steering "3-Piece" bogies at a maximum axle load of 18.5 tons on 48 kg/m rail.

During the seventies a Self Steering Bogie (in South Africa commonly referred to as a Scheffel or HS bogie) was developed by Dr. Scheffel (the inventor) and a team of engineers on the Railways.

This bogie not only reduces the contact stress between the wheel and the rail but also have negligible lateral forces in curves compared to a 3-piece or rigid frame bogie.

The result of this was that the civil department made a concession to increase the permissible axleload to 20 tons on 48 kg/m rail in the case where Scheffel type bogies are used.

A handwritten signature in black ink, appearing to read "F.S. Maree".

F.S. Maree

3 Sept 2009.

Principal Engineer
Track Technology
Technology Management
Transnet Freight Rail
JOHANNESBURG.



Contact a Global Railway Engineering service representative for more information on the Scheffel Self Steering Bogies or visit <https://www.globalgroups.org>

HS Scheffel Bogies: Revolutionizing the Railway Industry, lowering operational cost of running wagons.

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