HENCON

SERVING PROGRESS

T-TRACK

BALLAST-LESS SLEEPER-LESS RAILWAY SYSTEM

T-TRACK

www.henconmining.com

T-TRACK BACKGROUND

Developed in South Africa in 1989, the T-Track system is a unique, ballast-less track structure.

It was designed to offer a more cost-effective solution than the conventional ballasted track typically used in the rail industry which is associated with significantly higher maintenance costs. The ballasted system also requires specialised on-track machinery to maintain the track geometry and the ballast.

However, since T-Track does not use ballast or sleepers, the system has fixed geometry and requires less maintenance and component replacement. As such, life cycle costs and total cost of ownership is significantly lower with T-Track.

HOW DOES T-TRACK WORK?

The T-Track system offers continuous support to the rails which are braced on longitudinal reinforced concrete beams.

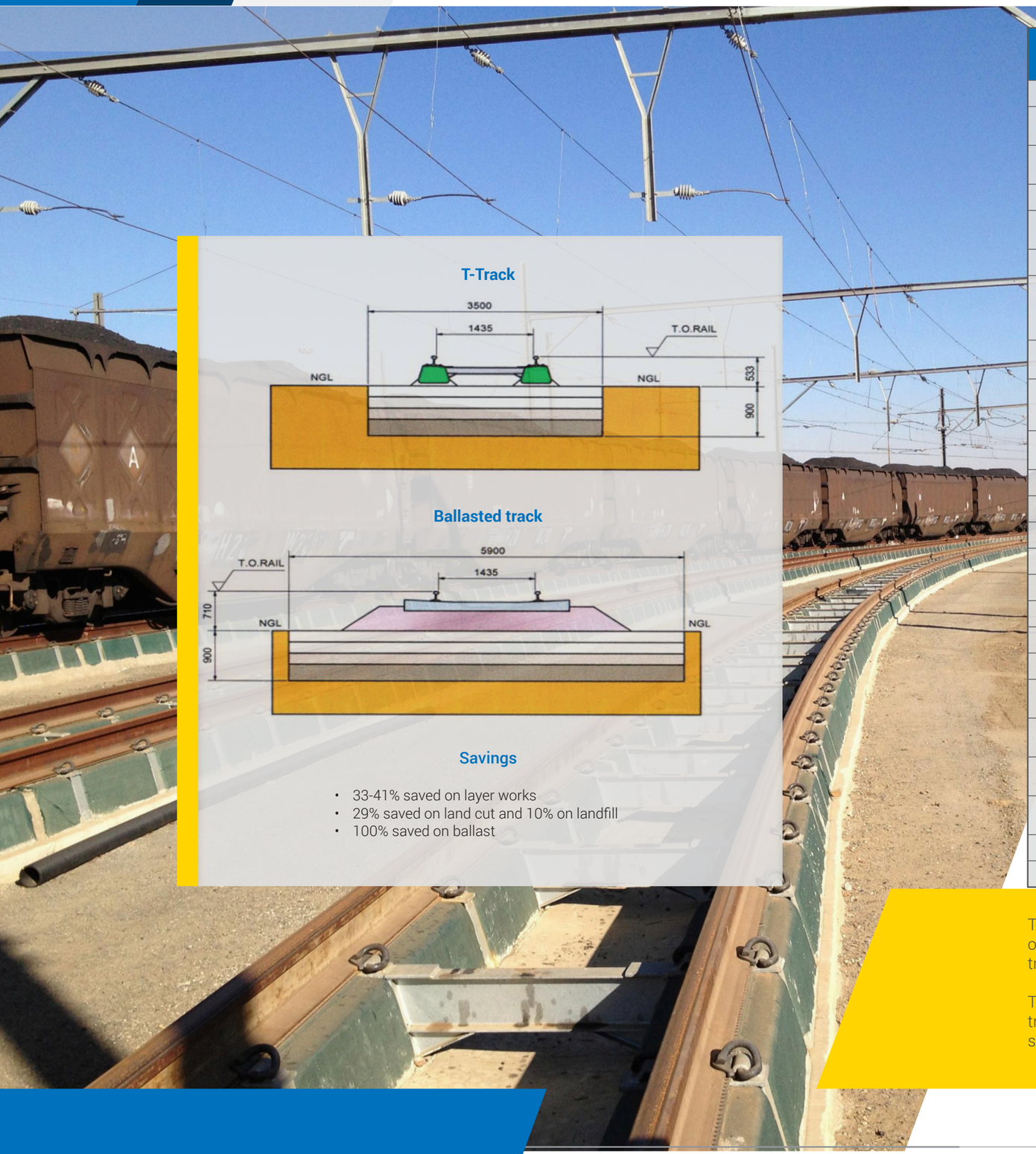
Galvanised steel gauge bars provide the desired track gauge by spacing them according to the particular application and design requirements. T-Track can be used for any track gauge, rail size and axle loads. Current application designs in service run from 5-ton axle loads in the mining industry up to 32,5-ton axle loads on surface applications.

Due to the continuous support of the rails including the continuous resilient pad between the rail and the beam, rail stresses and fatigue are reduced offering longer service life.

The modules are cast for open track and turnouts in dedicated moulds in a factory environment to maintain absolute quality assurance and control. Manufacturing tolerances of 1mm are achieved in the moulds offering the T-Track system excellent track geometry.

T-Track modules are logistically convenient and can be easily transported by road or rail. Modules will always be in the order of 3m to 6m in length depending on the application. T-Track components are manufactured by the OEM and easily transported to any destination where the modules are physically cast.

**Important note:* *When casting the beams, plastic tubes can be inserted into the cast modules for the installation of fibre-optic communication lines, eliminating the need for channels and trenches when communication cables need to be laid. Various alternative approved fastening systems can be used that are suitable to the T-Track system.*



T-Track

Ballasted track

Savings

- 33-41% saved on layer works
- 29% saved on land cut and 10% on landfill
- 100% saved on ballast

	FEATURES	T-TRACK	SLAB TRACK SYSTEMS		CONVEN-TIONAL BALLAST TRACK	PERFORMANCE
			LVT	EMBEDDED TRACK		
1	Capital expenses	4	2	2	4	T-Track compares favourably with CBT. Other ballast-less track systems (slab track) have higher capital costs.
2	Continuous rail support	5	1	5	1	T-Track provides simple continuous rail support. To obtain continuous support in systems on a slab base, the rails are embedded in concrete.
3	General maintenance of rails	5	5	1	5	Maintenance of ballast on CBT requires the use of special high cost on-rack equipment. T-Track does not require this as there is no ballast.
4	Rail accessibility	5	5	1	5	In the case of rails cast in concrete, the destruction and re-installation of the slab base is required.
5	Environmentally friendly	4	3	2	1	T-Track does not need crushed stone. Other systems on a slab base need crushed stone in concrete production and crushed stone is required for sleepers and the ballast bed for CBT.
6	Engineering and technical expertise on-site (low installation resources)	4	2	1	2	The T-Track modules are pre-cast in a factory similar to the CBT sleepers.
7	Construction technology	4	2	1	1	T-Track construction is very simple to construct and requires minimal on-site concrete input, engineering and standard plant and equipment (not on-track). Other track slab systems require specialised engineering input on-site. CBT requires a lot of special on-track equipment.
8	Modular construction	5	3	1	2	Other open rail slab track systems do not provide continuous support to the rails. Smaller rail sections can also be considered on T-Track due to continuous support.
9	Uplift and re-use of modules	5	2	1	3	T-Track modules can be up-lifted and re-used at a different site. In other track slab systems, concrete slabs cannot be re-used elsewhere. CBT allows you to re-use the sleepers and a small percentage of the ballast.
10	System weight	4	2	2	2	The mass/meter of CBT is almost twice that of T-Track on track gauges 1435mm and wider. Other track slab systems are even heavier due to the weight of concrete.
11	Vertical deflection of rail	5	2	5	2	T-Track and embedded track provide continuous support.
12	Horizontal deflection of rail	5	5	5	2	The highest is on CBT.
13	Long term maintenance costs	4	3	2	1	Maintenance of the CBT requires the use of expensive rail bound equipment on a regular basis depending on traffic volume.
14	Localisation of the work process	4	3	4	4	Client can use local suppliers to buy and deliver material.
15	Emergency track recovery	4	4	2	2	Time to repair the track after accidents is shorter.
16	Dirty track characteristics	5	5	5	3	High level protection against sand, mud, water.
17	Top of rail	4	3	4	1	T-Track top of rail can be installed on same level as surrounding ground level.
18	Adaptability to various axial loads	5	1	2	5	Track can be used with axial loads from 5 to 42.5 t. (current designs).
19	Opening of line	4	1	1	5	Slab base requires minimum 28 days for the hardening of concrete before traffic can resume. T-Track can be used after 5 to 7 days. CBT immediately.
20	Ability to work on different parts of the track	5	5	5	1	CBT requires the track for moving construction equipment. T-Track can be mounted from accessed from at various locations along the line without the use of rail bound equipment.
21	Formation width	5	4	4	1	Slab track systems can be built on a narrower formation. T-Track can be constructed on a 4m wide formation even for 1 520mm gauge track.
22	Track installation	5	5	5	1	T-Track can be installed simultaneously at several locations along the line. Bridges, culverts and other civil structures are therefore not critical items on the installation program.
		90	63	61	58	
	Scale 1-5	5	3,5	3,4	3,2	

T-Track combines two important qualities that are absent in other systems, namely: continuous rail support and open rail fastening to the beam. A rail can be removed, replaced or serviced at any time without any damage to the track system.

The capital cost of the T-Track system is similar the cost of ballasted track and significantly lower than other slab track systems. Using T-Track for extended track lengths can reduce the capex by up to 10% compared to CBT. This system is geometrically very stable and requires up to 90% less maintenance than CBT.

Geometrical parameters of the truck

- Vertical deflection is less than 2mm, horizontal deflection is less than 1mm
- No longitudinal creep

Continuous beam support

- It allows for a smaller rail size for the same load
- Reduced rail corrugation
- Reduced vertical rail deflection – less rail fatigue and stresses
- Equal load distribution along the welded rail
- Continuous support at rail breaks reducing potential derailments
- Eliminates rail creep

No sleepers and ballast

- Reduced environmental footprint
- No high-cost ballast maintenance and on-track maintenance machine

Lower operation and maintenance costs

- No need to tamp, screen and profile ballast
- No need for ballast trains to deliver ballast
- No need to keep ballast stock piles and quarries
- Operational availability of T-Track higher than CBT

Quick replacement and repair in case of a damage on the line

- Modular system allows quick installation of the track by means of replacing modules if required. Traffic can be quickly recommenced at certain restricted speeds if required in the affected area.

Better drainage features

- Water is not collected by contrast to ballast
- Water concentration can be visually detected and dealt with immediately
- Simple/easy water drainage systems
- Corrosion resistance (components are hot dip galvanised)
- Re-inforcing in the modules are protected with concrete cover of low permeability

Module structures are not exposed to cracking

- Concrete does not crack because of localised settlement of formation – modules have bridging effect
- No cracking of sleepers when ballast is contaminated
- Simplicity and low cost of grout refilling in case of embarkment dipping
- Elasticity is achieved through use of rubber pads

Stability of the crossing constructions

- Pre-cast level crossing blocks simple to install between the rails and creates safe access across tracks

Reduced time for repair

- 80-90% of maintenance is visual inspection of the tracks, 10-20% is physical work
- Various T-Track installations have been in operation in excess of 12 years with no maintenance
- Turnouts on the T-Track system have extended life. In SA, on heavy haul installations, turnout life has outperformed CBT turnouts by at least 2 times

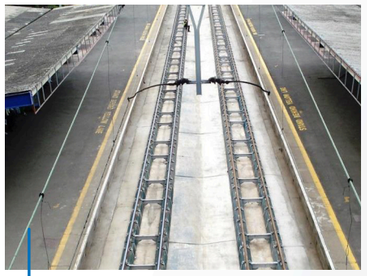
T-Track is well suited for the following applications:

Desert Conditions	Level Crossings	Wash Bays
Main Lines	Loading Facilities	Underground Installations
Metro & Platforms	Heavy Haul Lines	Turnouts
Tram Systems	Container Yards	

Dessert Applications

Main Lines

Metro & Platforms

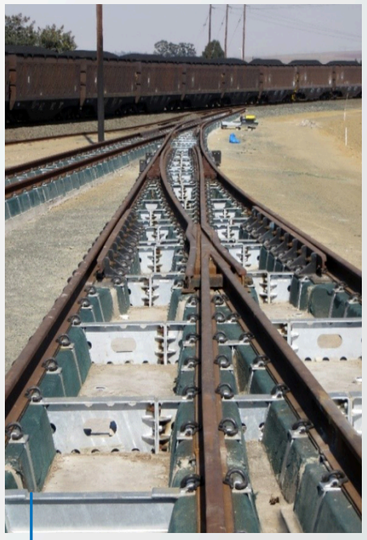


Tram Systems

Loading Facilities

Heavy Haul Lines

Underground Installations



Turnouts

Wash Bays

ADVANTAGES OF T-TRACK

Simple Installation

- Reduced earthwork and formation widths from 30-40% saving on greenfield projects
- Rails are continuously supported
- Significantly reduces track maintenance
- Ballast-less system – eliminates logistics associated with ballast operations
- Ability to protect the formation against flash flooding damage by introducing sacrificial topping layers
- Increased track availability
- Economical track solution
- Lowest cost of ownership

DESERT APPLICATIONS

T-Track is ideally suited for desert and sandy environments as it is ballast-less. Sand has no impacton the performance of T-Track.

Whether the system is installed in deserts with moving dunes or just wind-blown sand, no ingress of sand can take place between the rail and beam. This is where the resilience of the system takes place. The continuous resilient pad will always perform as it's designed to do.

Should the track be covered by sand, it is easy to open the line using standard machinery like bulldozers, front end loaders and skid steers. Locomotives and/or tractors with a scraper attachment can also be used to simply expose the rail heads for safe passage of trains.

Over 75km of T-Track has been installed in desert environments, and to date the sand has had no negative impact on the system.

In 2008, a section of desert track was opened in Saudi Arabia with a 1 435mm gauge and 32,5-ton axle load. To date, ZERO maintenance has been required. The track carries in the order of 6 to 7 million tons of freight per year.

"DESERT SAND HAS NO IMPACT ON THE PERFORMANCE OF THE T-TRACK SYSTEM"

DESERT APPLICATIONS

Desert applications

Desert applications

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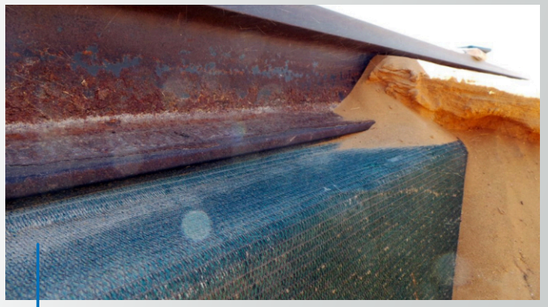
Desert applications



Resilient pad between rail and beam – no ingress of sand

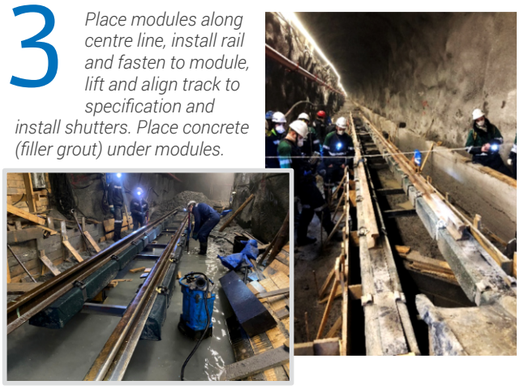
Desert track in Saudi Arabia

TYPICAL UNDERGROUND INSTALLATION SEQUENCE

1 *Transport modules underground*

2 *Footwall preparation*

3 *Place modules along centre line, install rail and fasten to module, lift and align track to specification and install shutters. Place concrete (filler grout) under modules.*



4 *Remove shutters. T-Track installation complete*

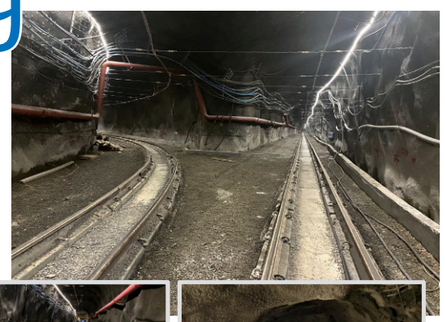
5 *Backfill side of track for walk ways*

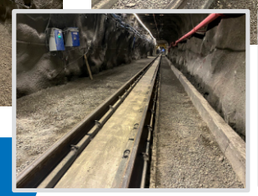
6 *Open line for operations*

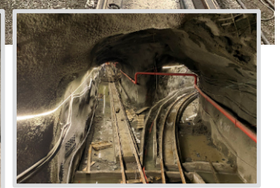
7 *Train loading station*

8 *Train un-loading station*

9 *Finished T-Tracks*







CASE STUDY: UNDERGROUND INSTALLATION

T-Track in Russia

CASE STUDY: UNDERGROUND INSTALLATIONS

+10 m level project

Customer: **PhosAgro, Kirovsk Branch of Apatit JSC.**

Location: **Kirovsky mine**

Years of implementation: **2020-2022**

Length: **8 km**

10-year warranty for T-Track

Gauge: **750mm**

Axle load: **15 tonnes**

Annual gross tonnage: **5 million tons**

4 x Hencon 30t electric locomotives

36 x Hencon mine cars 10m³

15 x Hencon loading stations

4 x Hencon unloading stations

Average ore density: **2.0 t/m³**

Number cars in train: **8-12**

Maximum train speed: **25 km/h**

Average train speed: **12 km/h**

Operational gradient: **0.5%**

Curves radious: **50 m**

Number working days: **305 per annum**

Number shifts per day: **3**

Number hours per shift: **7**

- JSC Apatit is a member of the PhosAgro Group, founded on 13 November 1929 and which owns the Kirovsky Mine located on the Kola Peninsula.
- Kirovsky Mine is increasing production by launching a new horizontal horizon at +10m level.
- +10m level horizontal horizon will support planned production from the Kukisvumchorr and Yukspor deposits.
- Estimated production from the Kukisvumchorr deposit is 5 million tons planned by 2030.
- Estimated production from the Yukspor deposit is 7 million tons planned by 2033.
- Mine is operating mine-wide WiFi enabling real-time information flow, better decision-making and increased production.

+90 m level project

- Implementation period: **2014 - 15**
- Annual gross tonnage: **6 min tons**
- Track length: **9km**
- Gauge: **750mm**
- Axial load: **10 tons**
- Turnouts: **48**

To complete these two projects, production and delivery of T-Track modules was done on-site at Hencon Siberia Ltd. in Apatit, Murmansk region (the Arctic Circle). By successfully implementing and operating the T-Track ballast-less system on narrow-gauge mine tracks in Russia, we have demonstrated both the technical and economic potential of using this innovative solution in tunnels and on the main track's loading platforms.

T-Track in South Africa

The total length of the T-Track installed above and below ground in South Africa is in excess of 500km.

More than 380km are laid in underground mines; 130km in open and main lines and 15km in suburban platforms. There are currently 90 turnouts in operation as well.

The use of a ballast-less T-Track system significantly reduces the environmental burden, as it leads to a significant reduction in inert materials and the volume of excavation during construction and operation, as well as a reduction in noise and vibration when rolling stock is moving.

Promising future directions for T-Track system implementation include public railway tracks, underground railroads and urban railways which will bring the advantages of this new technology to everyday life, and not just to mines and industrial complexes.

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SERVING PROGRESS

The T-Track system has been tested, certified, accepted and implemented in the following countries:

- Brazil
- Canada
- Namibia
- Republic of South Africa
- Russia
- Saudi Arabia

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