03.26 1/3 Version E – preparing the crane track

A carefully designed and constructed rail track assembly is essential for the safe erection and operation of a travelling tower crane.

Some important rules must be observed when preparing the rail system:

Base / nature of the ground
The proper design and construction of the tower crane rail track assembly is the responsibility of the jobsite mangement.

The base for a crane track must be on firm ground (no marshy ground or similar). The permissible ground pressure should be checked by a certified structural engineer who is familiar with the local site conditions. It is advisable to compact the ground with suitable machines. If the ground needs to be filled up to provide a level base for the crane track, ground compacting is even essential. The load capacity of the ground is calculated from the corner pressures of the crane (**➔ Chapter Crane configurations "Version E - corner loads and horizontal forces"**).

Note:

The corner loads vary according to crane height, jib length and the positon of the crane jib in relation to the rails. The track assembly must be designed for the maximum corner loads in the worst loading condition. The worst loading condition will occur when the crane jib is positioned directly over one corner of the undercarriage / foundation cross.

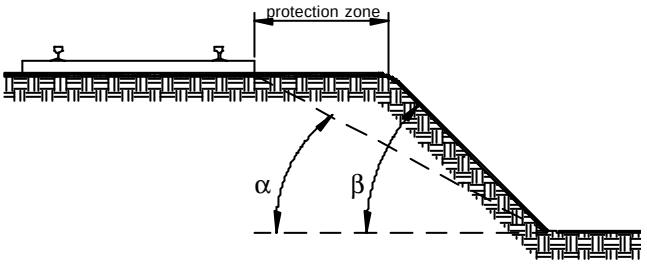
Laying the crane track
The undercarriage / foundation cross can be adjusted to move on either a straight or cruved track. Curved tracks can be either single turn or S-curved.

Note:

The undercarriage / foundation cross set for curve going can move on both straight and curved tracks. An undercarriage / foundation cross set for straight-going can move only on straight tracks.

The rail track assembly must be laid out and constructed so as to keep a safety margin of at least 500 mm / 20 inches between the most extreme part of the undercarriage and all structures, scaffolding, roadway boundaries or any other possible obstructions.

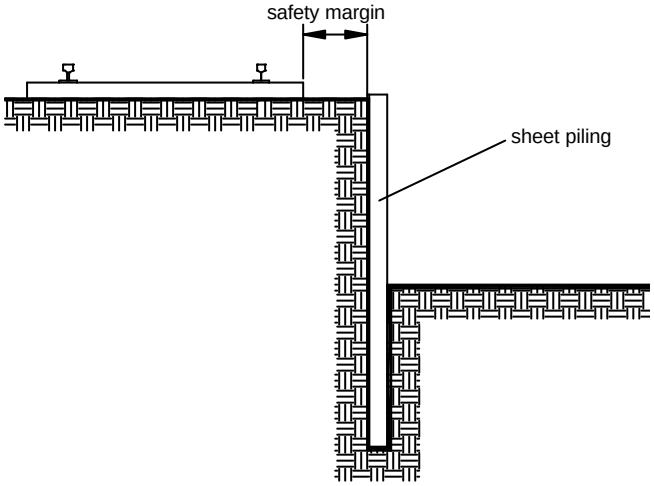
If the crane track is to be laid on a different level to the surrounding ground (e.g. crane near to the trench) it must be ensured that overloading or collapse of the crane track ground is impossible. This can be achieved for example by an embankment which must be such that it has a protection zone which takes up the load (see diagram). The width of the protection zone is dependent upon the nature of the ground, the greater the load capacity of the ground, the smaller the protection zone.



a = theoretical embankment angle
b = real embankement angle due to the protection zone

03.26 2/3 Version E – preparing the crane track

If there is not enough room for an embankment, another solution is necessary, e.g. supporting the crane track foundation with a sheet piling (see the following diagram). In this case, however, a safety margin of at least 500 mm / 2 ft must be maintained along the entire length of the rail track assembly between the crane track and the sheet piling.



WARNING:
If this safety margin cannot be kept at any point, the affected area must be fenced off so that there is no risk of a person being trapped. Failure to follow this instruction is extremly dangerous and could lead to an accident resulting in property damage, serious injury or loss of life.

The track assembly must be at least 3.0 m / 10 ft longer at each side than the required travel range of the crane to allow a safe stoping distance. End stops or buffers must be fixed at both ends of the tracks to prevent the crane from running off the track.

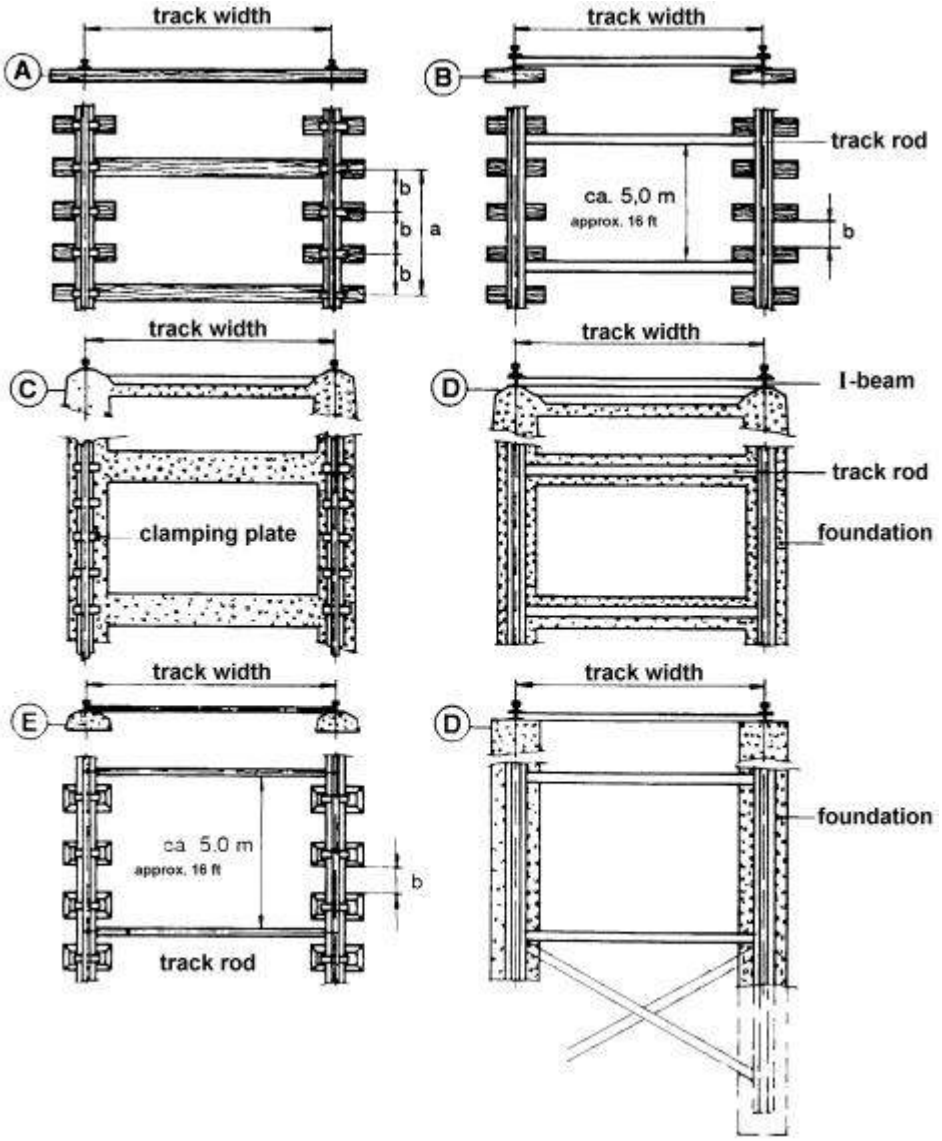
WARNING:
The end stops and limit switch strikers must be securely installed before beginning erection of the tower crane. Failure to follow this instruction is extremly dangerous and could lead to an accident resulting in property damage, serious injury or loss of life.

Note:

A travel limit switche is installed on the undercarriage / foundation cross.

03.26 3/3 Version E – preparing the crane track

Crane track types
The crane track type must be selected. Crane tracks are available in different forms. The most common ones are those shown in the following diagram.



Crane track type A:
Rails on sleepers
(➔ **Chapter Site preparation "Version E - rails on sleepers"**)

Crane track type B:
Rails on I-beams and sleepers
(➔ **Chapter Site preparation "Version E - rails on I- beams"**)

Crane track type C:
Rails on concrete strip foundation
(➔ **Chapter Site preparation "Version E - rails on concrete strip foundation"**)

Crane track type D:
Rails on I-beams and concrete strip foundation
(➔ **Chapter Site preparation "Version E - rails on I-beams"**)

Crane track type E:
SRS crane track system
(➔ **Chapter Site preparation "Version E - SRS-crane track system"**)

Note:

At the end of the crane track the track rods must be crossed for reasons of stability.

03.27 1/2 Version E – rails on concrete strip foundation

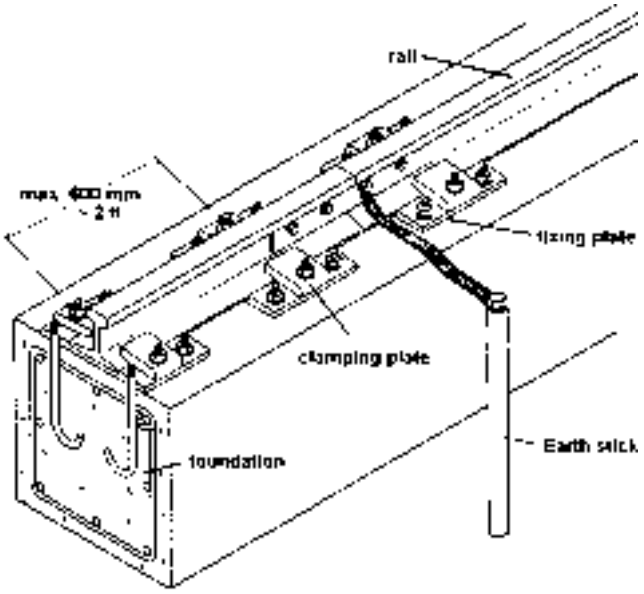
If the rails are to be laid on a concrete strip foundation, the dimensions of the foundation must be calculated from the corner loads or wheel pressures. The permissible resistance values may not be exceeded.

To keep in track and to secure against one-sided shifting (wandering) of a concrete foundation, both concrete strips must be interconnected. Either reinforced concrete beams or steel sections are used for this.

If foundations for curves are also required, these must be laid concentrically. The smallest inside radius may not be exceeded in any case (**➔ Chapter Site preparation "Version E - tracklaying in curves"**). The track width must be kept constant in curves, special attention needs to paid to this particularly when installing the fastenings for the rails. The track may not be raised in curves, therefore the foundations must be set up on the same level.

Attention must be paid to the correct connecting of rails and foundation when creating the foundation. There are several ways of fixing the rails to the foundation:

1. The rails are laid directly on the concrete foundation and fixed with clamping plates bolted to the foundation. For fixing the clamping plates either stone bolts should be used after laying the rails or threaded anchors should be cast in the concrete when creating the foundation. The rail legs must be underconcreted in any case so that the rails have full ground contact.
2. The rails are placed on fixing plates bolted to the foundation and fixed with clamping plates. To bolt the fixing plates to the foundation, either stone bolts are used or threaded anchors must be cast in the concrete when creating the foundation. The size of the fixing plates must be chosen according to the load (corner load or wheel pressure) so that the permissible pressure tension between the steel (fixing plates) and the concrete (foundation) is not exceeded. The max. distance between the individual fixing plates exceed 600 mm / 2 ft.



03.27 2/2 Version E – rails on concrete strip foundation

Note:

Fixing plates for railway tracks may not be used because they have an inclination of 4°. The rails therefore lie at an angle and the running surfaces of the wheels on the track carriage would only contact one point of the rail head. In this case both the running wheels and the rails would be subjected to an extremely high wear. Safe crane operation would then no longer be possible.

1. The rails are laid on I-beams made of steel which are bolted to the foundation. To bolt the I-beams to the foundation either stone bolts must be used or threaded anchors must be cast in the concrete when creating the foundation. The I-beams must be underconcreted so that they are in full contact with the foundation. Further information ➔ **Chapter Site preparation "Version E - rails on I-beams"**.

The foundation reinforcement must be earthed. This must be taken into account already in the creation of the foundation (➔ **Chapter Site preparation "Version E - earthing of crane tracks"**).

If the crane is also to be used in winter, the concrete foundation must be grounded frost-free.

03.28 1/2 Version E – rails on sleepers

There are basically three different kinds of sleepers:

1. Wooden sleepers
2. Concrete sleepers
3. Steel sleepers

The choice of sleeper type depends on the load. The surface pressure between the sleeper and the ground may on no account exceed the permissible value. Permissible values can be found in the national regulations (in Germany DIN 1054).

1. Wooden sleepers

Wooden sleepers can only be used for low loads. As a rule the loads which occur when operating a crane of the SK or SN type are higher so that in practice wooden sleepers are seldom used for the crane track. The max. distance between the wooden sleepers exceed 600 mm / 2 ft.

Nevertheless, the permissible loads for wooden sleepers are specified in the following table.

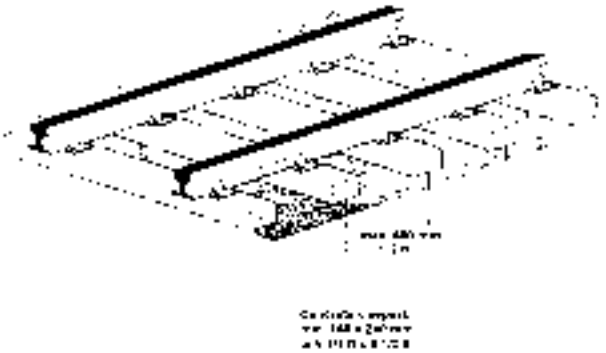
Kind of wood	Permissible curveing tension	Permissible surface pressure
Hard wood	1100 N / cm^2 or 230 kips / ft^2	300 N / cm^2 or 63 kips / ft^2
Soft wood	1000 N / cm^2 or 209 kips / ft^2	200 N / cm^2 or 42 kips / ft^2

NOTE:

Wooden sleepers can only be used up to wheel pressures of about 200 kN / 45 kips (rule of thumb). The sleepers should be made of a good quality wood and don't have any shakes and they don't be weather-beaten.

2. Concrete sleepers

Concrete sleepers must have a cross section of at least **160 x 24 mm or $6^1/_4$" x $9^1/_2$"** so that the forces applied can be dissipated into the ground through the gravel bed. The max. distance between the concrete sleepers exceed 600 mm / 2 ft. Keep care off a equidistance of tracklaying (tie rod).



Sleepers which do not lie beneath both rails (partial sleepers) may only be used as intermediate sleepers under the outside rails of a curve. Curves must be laid concentrically. The smallest inside radius may not be exceeded in any case (**➔ Chapter Site preparation "Version E - tracklaying in curves"**). The track width must be kept constant in curves, in addition the track may not be raised in curves.

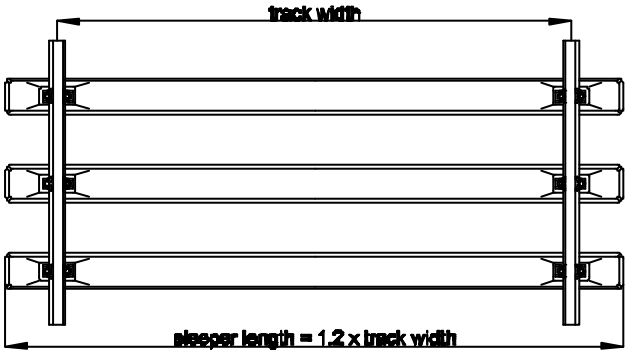
The use of concrete sleepers in subsidence areas, on frost-sensitive ground or soft ground is not recommended.

03.28 2/2 Version E – rails on sleepers

3. Steel sleepers

When using crane rails it is also possible to use steel sleepers.
For steel sleepers there is no prescribed minimum cross section as for example for concrete sleepers. Steel sleepers are available in different forms which is why no general statements can be made about the cross section. In any case the steel sleepers must be selected so that the forces applied can be dissipated into the ground through the gravel bed without the sleepers being deformed. The max. distance between the steel sleepers exceed 600 mm / 2 ft.

General
The sleeper length must be at least 1.2 time greater than the track width in order to be able to dissipate the applied forces through the gravel bed into the ground (see diagram).



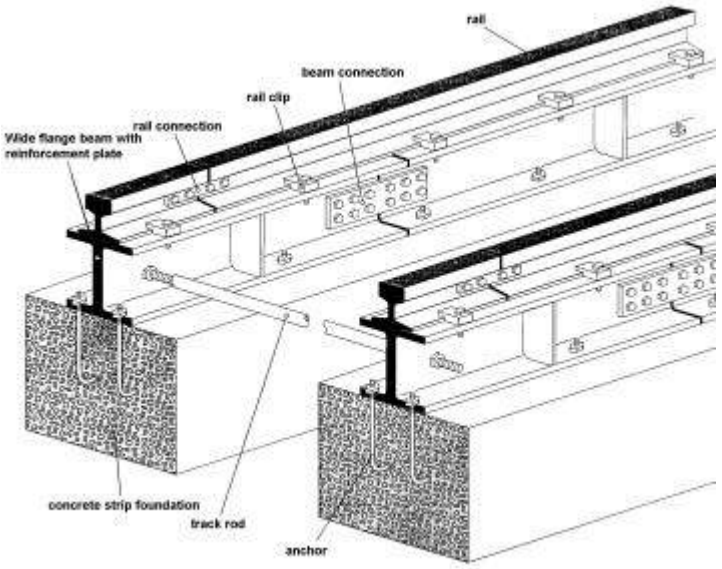
When using sleepers, fixing plates must be used generally.

NOTE:

Fixing plates for railway tracks may not be used because they have an inclination of 4°. The rails therefore lie at an angle and the running surfaces of the wheels on the track carriage would only contact one point of the rail head. In this case both the running wheels and the rails would be subjected to an extremely high wear. Safe crane operation would then no longer be possible.
The rail track assembly must be at least 3.0 m or 10 ft longer at each end than the travel range of the crane to allow a safe stoping distance. End stops or buffers must be fixed at both ends of the track to prevent the crane from running off the rail track.

03.29 1/1 Version E – rails on I-beams

I-beams are used as a track foundation when a very rigid crane track needs to be chosen. This may be an advantage at high loads or on uneven ground.



The size of the I-beams must be selected depending on the ground conditions, the applied loads and the local conditions. According to the same criteria, it must be determined whether the I-beam is to be laid on a gravel bed (**➔ Chapter Site preparation "Version E - rails on sleepers"**), individual concrete foundations, concrete slabs or a concrete strip foundation (**➔ Chapter Site preparation "Version E - rails on concrete strip foundation"**) .

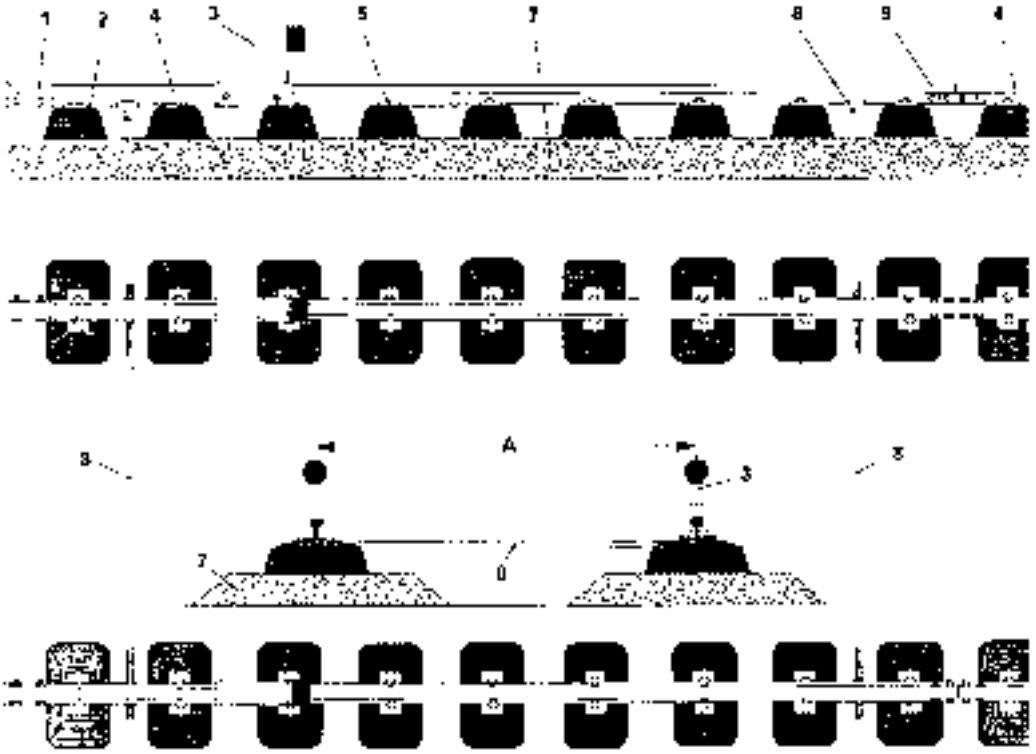
For stability reasons and because of the large surface area a wide flange beam must be chosen as a section. The rails (sections) should be the same length as the individual beams but fixed offset on the beams so that they overhang the top of the beam by approx. 100 – 150 mm / 4 inch – 6 inch and lie on the adjacent beam. Fixing is by rail clips, in addition the rails are secured by welded blocks against transverse shift.
The parallel track course is ensured by using track rods between the beams (see the following diagram). It is recommended to use track rods adjustable to different track widths.

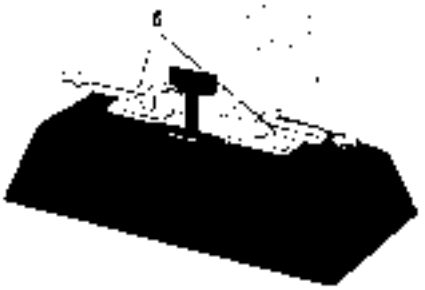
03.30 1/1 Version E – SRS crane track system

The SRS crane track system is a pre-assembled rail system consisting of simple, compact components with which practically any track course can be implemented. The concrete sleepers and rail form an inseparable unit, the rail track. In principle two single rail tracks are used which are fixed in the desired track width using track rods (see diagram further down). In addition to straight rail tracks (6.0 m or 20 ft) and and curved rail tracks (all radius are avaiable) there are points and crossovers as well as accessories such as rail end stops, contact rails for emergency end stop switches etc. The SRS crane track system is a time saving and low-cost alternative to a classic rail track.

Further information is available from:

Perker SRS Verkehrstechnik GmbH
Friedrich-Engels-Straße 6
D-14770 Brandenburg
Germany





1 rail end stop – end piece
2 concrete sleeper
3 rail end stop - buffer
4 rail
5 rail fixing
7 rail
8 track rod
9 rail connection

03.31 1/2 Version E - rails

Independent of the crane track type either special crane track rails or railway tracks can be used as rail material. The rails need not be new, the rail head may, however, only be slightly worn.

ATTENTION !
Rails which are heavily worn or even damaged may not be used on any account. Such rails endanger the safe standing of the crane.

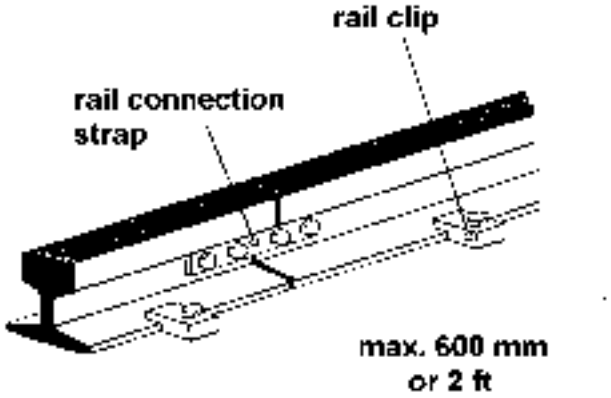
The selection of the rail section depends on the rail vehicle used and the corner pressure of the crane. In the following table the rail section to be selected for all TEREX-PEINER rail vehicles and respectively several corner pressures are specified. If the crane to be used has higher corner loads than listed in the table, the TEREX PEINER Serviceteam should be consulted to make the correct choice of rail section.

bogie	running wheel Æ mm inch	Wheel base bogie mm inch	useful running wheel width mm inch	max. corner load in operation kN (kips)	rail section		
F 320	2 x 320 2 x 12.5	405 19.9	76 3	400 (90)	S 49	S 54	A 55
				450 (101)	S 64	UIC 60	A 65
F 40/1	1 x 400 1 x 15.4	---	80 3.1	250 (56)	S 49	S 54	A 55
				280 (63)	S 64	UIC 60	A 65
				315 (70)	A 75		
F 400	2 x 400 2 x 15.4	498 19.6	80 3.1	500 (112)	S 49	S 54	A 55
				560 (125)	S 64	UIC 60	A 65
				630 (141)	A 75		
F 500	2 x 500 2 x 19.7	660 26.0	90 3.5	630 (141)	S 49	S 54	A 55
				710 (159)	S 64	UIC 60	A 65
				800 (179)	A 75		
F 630	2 x 630 2 x 24.8	800 31.5	110 4.3		S 49	S 54	A 55
					S 64	UIC 60	A 65
					A 75		
					A 100		

03.31 2/2 Version E - rails

Rail joints

At the transition from one rail to the next, i.e. at the rail joint, there may be no noticeable differences in height. Therefore the ends of the two rails must be connected with a strap bolted between the rail head and the rail foot. The bolt connection must be made with at least two bolts per rail (see diagram).



NOTE:

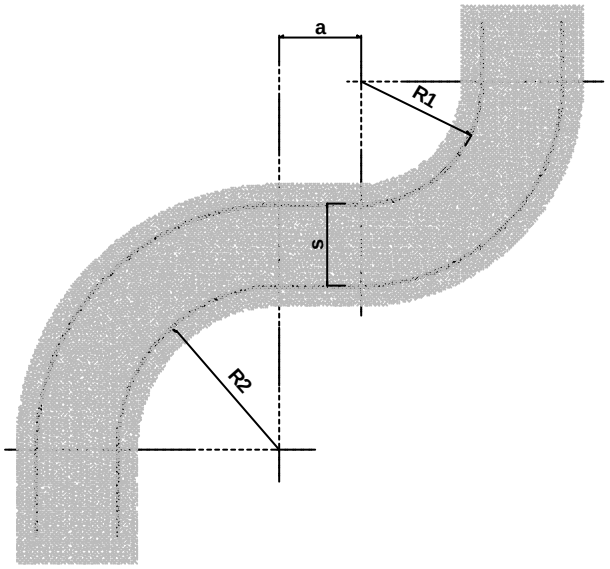
The straps should not be too long. Straps which would lengthen the distance between the sleepers or the clamping plates beyond 600 mm or 2 ft are not permitted.

03.32 1/1 Version E – tracklaying in curves

The curve radii specified in the table below are minimum radii and refer to the rail on the inside of the curve. If there is enough room for laying the crane rails with a greater curve radius, the curve radius should be selected as large as possible. The greater the curve radius, the better the driving comfort of the crane and the less wear on running wheels and rails.

NOTE:

In curves the lateral contact surfaces of the rail heads should be coated constantly with grease containing graphite. This minimizes wear on the wheel flanges.



track width s	min. curve radius for non-driven bogie R1	min. curve radius for driven bogie R2	intermediate straight in opposite curves a
4.0 m 13'-1"	**6.0 m** 19'-8"	**8.0 m** 26'-3"	**4.0 m** 13'-1"
5.0 m (UF) 16'-5"	**7.5 m** 24'-7"	**10.0 m** 32'-10"	**5.0 m** 16'-5"
5.05 m (FKF) 16'-7"	**10.0 m** 32'-10"	**10.0 m** 32'-10"	**5.0 m** 16'-5"
6.0 m 19'-8"	**9.0 m** 29'-6"	**12.0 m** 39'-4"	**6.0 m** 19'-8"
8.0 m 26'-3"	**12.0 m** 39'-4"	**20.0 m** 65'-8"	**8.0 m** 26'-3"
10.0 m 32'-10"	**15.0 m** 49'-3"	**25.0 m** 82'-1"	**10.0 m** 32'-10"

03.33 1/2 Version E – crane track tolerances

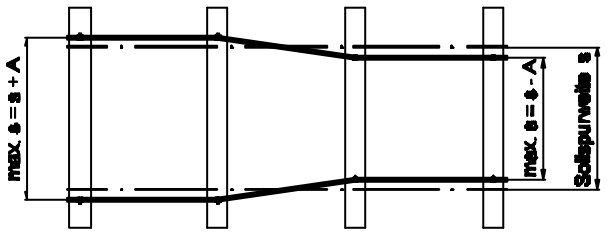
In Germany crane track tolerances are defined through DIN 4132 (edition February 1982) and VDI 3576. The following comments concerning crane track tolerances are meant to explain the prorated tolerances as described in the text of DIN 4132.

NOTE:

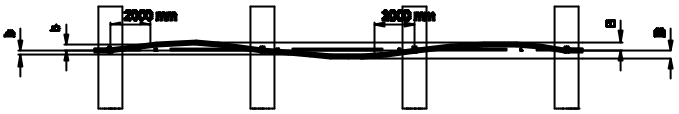
The person or company responsible for the crane operation is also solely responsible for the crane track being executed correctly and according to the up-dated edition of applicable standards at all times.
The crane manufacturer will take no responsibility for the correctness of the particulars given here.

Prorated tolerances

- **Track gauge deviations**
  A maximum deviation of measure "**A**" = **5 mm or 0.2 inches** is permitted for track gauges s up to 15 m / 50 ft.

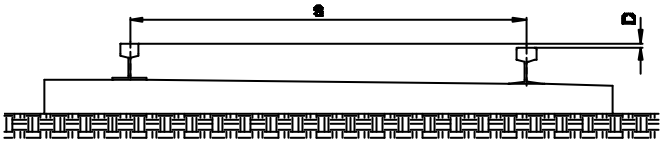


- **Lateral deviation**
  The permitted lateral deviation for one crane rail will be - maximum "**b**" = **1 mm or 0.04 inches** for any section of length 2000 mm / 6'-7". - maximum "**B**" = **10 mm or 0.4 inches** for the total length of the crane track.



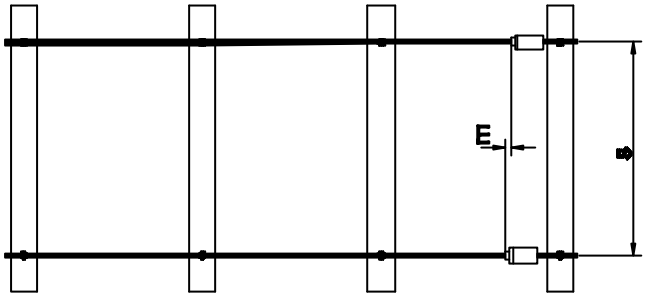
Height deviation for gradient
Permissible height deviation of a crane rail in longitudinal direction amounts to - maximum "**c**" = **1 mm or 0.04 inches** for any track section of a length of 2000 mm / 6'-7". - maximum "**C**" = **10 mm or 0.4 inches** for the total length of the crane track.

- **Height deviation for transversal slope**
  Permissible height deviation of a crane rail in transversal direction amounts to "**D**" = **0.002 x s** (**D_{max} = 10 mm**) for the total length of the crane track.

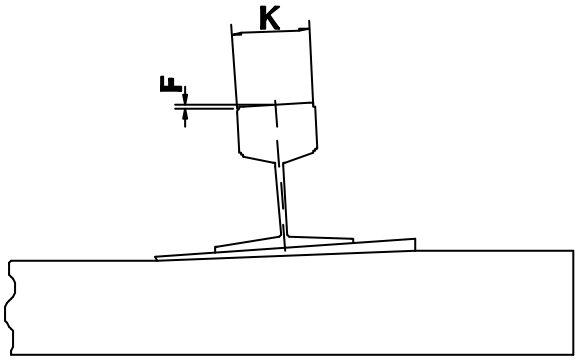


03.33 2/2 Version E – crane track tolerances

- **Transversal deviation of end-of-track safeguards**
  Permissible deviation in transversal direction for the end-of-track safeguards to each other amounts to "**E**" = **0.001 x s** (**E_{max} = 20 mm**).

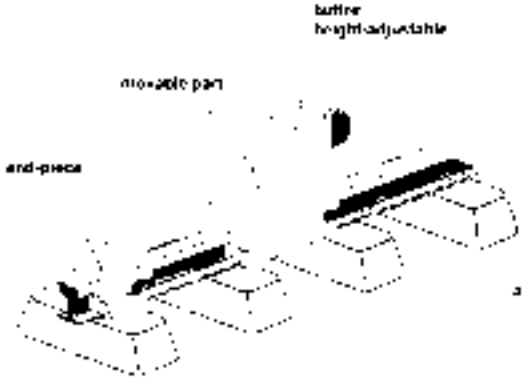


- **Height deviation between center of rail top and lateral edge of rail**
  Permissible height deviation between center of rail top and lateral edge of rail amounts to "**F**" = **0.008 x K**.

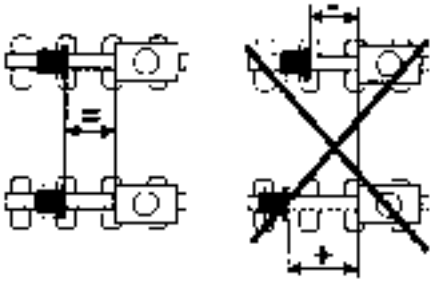


03.34 1/1 Version E – end-of-track safeguards

End-of-track safeguards must be fitted at the same height at both ends of the crane track. End-of-track safeguards consist of buffers and end pieces. The buffers must be fixed at an adequate safety distance "a" from the end of the rail. The distance "a" (see following sketch) should be selected so that at least one sleeper is located between buffer and end piece.



By moving the buffers along the length of the crane track, the crane inclines when it drives against them. This increases the stress on the supporting structure and increases the wear on the bogie wheel flanges. The buffers may therefore not be offset to each other too much. (**➔ Chapter Site preparation "Version E - crane track tolerances**).

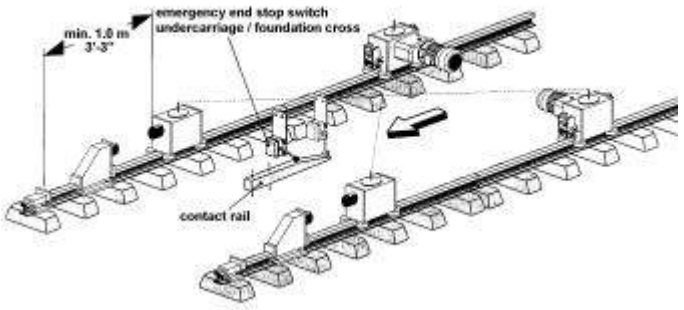


NOTE:

The buffer height must be adapted to the wheel carriage.

03.35 1/1 Version E – contact rail for emergency end stop switch

At both ends of the crane track, a contact rail must be fitted which activates the emergency end stop switch. The contact rail must be installed so that the crane comes to a stop at least 1.0 m or 3'-3" before the rail buffer from full speed.



NOTE:

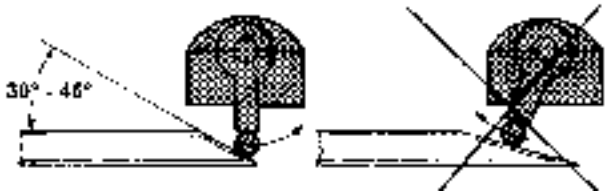
If the length of the power cable on the cable drum is shorter than the length of the crane track, the contact rails for the emergency end stop switch must be set so that the crane comes to a stop from full speed and there is at least 1.0 m or 3'-3" cable still on the drum.

The contact rail must be long enough so that the emergency end stop switch is still activated after the crane comes to a standstill. To prevent the activating lever of the emergency end stop switch slipping to the side, the width of the contact rail must be selected accordingly and the contact rail must be fixed parallel to the crane track (see diagram below). In addition the fixing height must guarantee safe activation of the emergency end stop switch. If when checking the activation procedure, it is detected that the contact rail is too low, it must be placed in a higher position.

ATTENTION!

After passing the contact rail the crane must not be able to proceed in the same direction. Therefore the emergency end stop switch must also be activated after the crane comes to a standstill. It is then always possible to move in the opposite direction.

To ensure that the activating lever of the emergency end stop switch is deflected jolt-free, the contact rail must have a contact angle of 30°-45°. If the contact angle is narrower, the activating lever can be deflected in the opposite direction (see diagram), the activation procedure is no longer smooth enough at too steep a contact angle.



03.36 1/2 Version E – earthing of crane tracks

NOTE:

It is the responsibility of the jobsite mangement to check the using of lightning protection and / or earthing.

To be noted when earthing crane tracks:

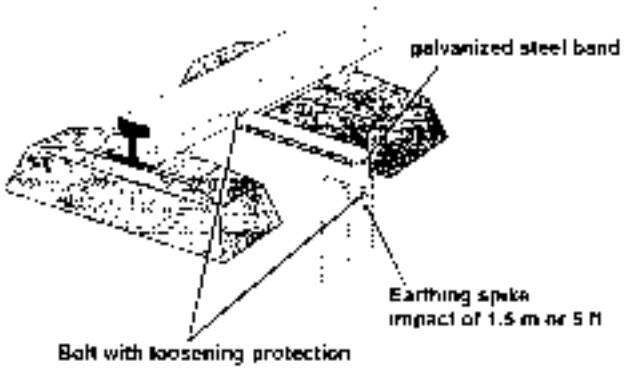
1. General regulations on earthing (from regulations and standards, etc., in Germany e.g. VDE)
2. Local regulations for lightning protection and earthing

1. General regulations on earthing

An earthing point must be made so that the earthing of the crane and thus the safety of the operating personnel is guaranteed. It basically applies: The greater the surface of the earther which is in contact with the surrounding ground, the better the earther fullfils its function.

To guarantee sufficient earthing of the crane, every rail must be earthed at each end of the crane track and additionally every 20 m / 66 ft if the track is longer than 20 m / 66 ft. In so far as apparatus, machines, metal pipes or similar are located in an area of 20 m / 66 ft around the crane track, these must be earthed separately. This can be achieved either by an available earthing point, an own earther or connection to the rails.

To earth crane tracks, use either existing earthing points or drive earthing spikes into the ground at least 1.5 m / 5ft.
Galvanized steel band with a minimum cross section **of 30 x 3.5 mm or1.2 inches x 0.14 inche**s is sufficient as a connection line to the earthers (see following diagram). The steel band is fixed to the rails and the earthing spike with one bolt connection respectively which must be protected against loosening (counternut, spring washer or similar).



NOTE:

An additional bridging of rail joints which are connected by steel straps is not necessary for earthing.

For crane tracks on a concrete (strip) foundation, the foundation reinforcement must be earthed. For this purpose a connection must be made between the foundation reinforcement and the rails. In the concrete strip foundation each of the two individual foundations requires a connection line to the corresponding rail track.

Connect climbing cranes 2 times.

03.36 2/2 Version E – earthing of crane tracks

2. Local regulations for lightning protection and earthing

⚠DANGER

When laying the foundations the local regulations for ligtning protection and earthing must be observed. These regulations must be inquired from the local acceptance authorities (usually the energy supply companies). Failure to observe these regulations is extremely dangerous and can lead to material damage and/or personal injury.