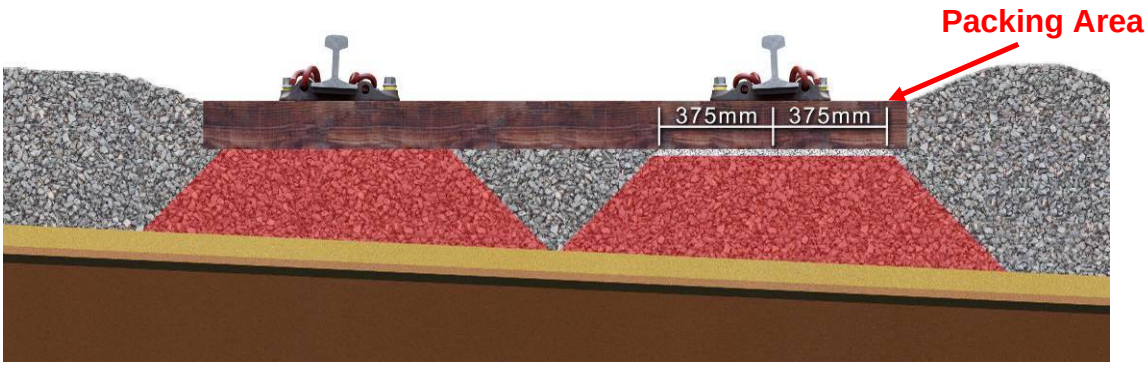
Track Work Information Sheet 2T007
How to carry out measured shovel packing (MSP)

Introduction

This task covers the measured, lifting & packing of track in plain line including adjustment switches. It includes the marking up using cross-level; void meters, sighting boards, the opening out of part bays, the chipping / packing as required, refilling of the ballast crib and re-profiling the ballast.

Overview

Ballast spreads the load from traffic through a load bearing pyramid which under the passage of trains, are subjected to dynamic loads. Unchecked these loads can cause voiding and then poor track geometry.



Measured shovel packing is an accurate, durable and manual way of packing the sleepers to remove voids, and correct both longitudinal and cross level. It can, reduce bad rides and prevent the onset of cyclic top and twists faults.

MSP is often the only way to maintain some of the older track as ballast conditions are not suitable for mechanised maintenance, and the fastenings not strong enough to cope with the lifting processes involved.

Work needs to be re-inspected after the passage of trains to confirm no localised settlement has occurred.

Risks & Control Measures

This TWI does not include any generic safety or risk information although it does detail some relevant cautions. Risk control measures detailed in the relevant Work Activity Risk Assessment or Risk Control Sheet must be implemented as required.

Competence

The site supervisor of this activity must be authorised and competent to deliver this safety critical task.

Track Work Information Sheet 2T007
How to carry out measured shovel packing (MSP)

Critical Rail Temperature

You must not start work if

- The rail temperature is greater than 32ºC
- The rail temperature is greater than the Critical Rail Temperature CRT (W) if less than 32ºC)
- The rail temperature is forecast to exceed 38ºC within the next three days.

Work must be stopped if the rail temperature rises above either 32ºC (or the CRT (W) if less than 32ºC). The track must be fully ballasted and the temperatures monitored for three days following. If temperatures exceed the CRT(W), protective action against buckles shall be taken

If the temperature starts to rise rapidly towards 32°C or the CRT then report back immediately. Be prepared to apply an emergency speed restriction, especially if there is insufficient ballast, stop lifting and box in.

Do not attempt to start work if the rail temperature is likely to drop below 0ºC.

General delivery information

- Are there markers or datum plates showing track level or giving alignment? There is a risk the alignment could be disturbed during the lifting process, so lift the rail with the jack in a vertical position.
- Will the ballast and track component condition allow the track to be lifted and packed satisfactorily?
- Where possible, always lift the track towards oncoming traffic starting from the back of the worksite, resulting in a smoother, safer train path while working.
- To avoid introducing a twist fault, both rails must be packed together.

Planning and Productivity

Standard job ref – 9309
MNT code - 019
Norm time per yard - 0.42 hrs
Standardised time per yard – 0.3 hrs

Labour Requirements	Scope 3 staff
	Deliver 6 staff
	Check 3 staff

Track Work Information Sheet 2T007
How to carry out measured shovel packing (MSP)

Delivery Process for 1 Rail Length (26 sleepers)

	Cumulative time (minutes)	5	10	15	20	25	30	35	40
		Scope							
1	Identify location of defect Identify correct lifting methodology and any remedial works.	3 staff - 5 mins							
2	Select reference rail	1 staff - 3 mins							
3	Place void meters	1 staff - 6 min							
4	Take cross level readings	2 staff - 4 min							
5	Select reference rail high spots	2 staff - 1 min							
6	Take sighting board readings	3 staff - 3 mins							
7	Take void meter readings	3 staff - 5 min							
8	Calculate Lifts, mark up site and paperwork	1 staff - 4 min							
		Deliver							
1	Identify worksite from paperwork and on site markings. Take datum point and rail temp readings	2 staff - 2 min							
2	Dig out bays	6 staff - 6 min							
3	Jack rail	2 staff - 5 min							
4	Pack Sleepers	4 staff - 24 min							
5	Lower rail	2 staff - 2 min							
6	Check cross levels	2 staff - 2 min							
7	Fill in bays and re-instate ballast profile	6 staff - 4 min							
		Check							
1	Check after required consolidation period	3 staff - 5 min							

Track Work Information Sheet 2T007
How to carry out measured shovel packing (MSP)

Tools, Plant and Materials that may be required-

Tools	***Number***
Cross level gauge.	1
Chalk / crayon and spray.	As required.
Void Meters.	2 per sleeper.
Void meter step gauge.	1.
Track lifting boards.	1.
Jacks – Obstruction less if lifting red zone.	2.
Ballast shovels, forks and picks.	As required.
Swan neck shovel.	2.
Chippings canisters.	2.
Wheel barrow / basket.	As required.
Rail Thermometer.	1.
Tape measure.	1.
Materials	
14 mm Granite Chippings.	As required.

Delivering Measured Shovel Packing -

If you are not measuring a gap and then filling using measured amounts of 14mm chippings, you are not MSP'ing.

The MSP task should be delivered in three separate stages; Scoping (measuring), Delivering (doing) and then Checking. Scoping could be done as a separate job, prior to a team being sent to rectify a fault.

Scope

PROCESS DECISION MATRIX FOR PACKING SLEEPERS

Job Number	Process	Good (Sharp)Ballast	Poor (Rounded/Contaminated) Ballast	Wet Bed	Non Steel Sleepers	Steel Sleepers	Permanent Fix	Temporary Fix	Quick Fix	Level Crossings
9309	Measured Shovel Pack	✔	✔	✔	✔	✘	✔	✘	✘	✔
9116	Lift and Pack	✔	✔	✘	✔	✘	✔	✔	✔	✘
9308	Kango Pack	✔	✘	✘	✔	✔	✔	✔	✔	✘
9233	Lift and Pack Joint	**Use process as above**								
9112	Tamper	✔	✔	✘	✔	✔	✔	✘	✘	✔
9113	Stoneblower	✔	✔	✔	✔	✘	✔	✘	✘	✔
9118	Stoneblow by hand	✔	✔	✔	✔	✘	✔	✘	✘	✔

✔ **Preferred Option**
✔ **Acceptable Option**
✔ **Least Preferred Option**
✘ **Do not use**

Track Work Information Sheet 2T007
How to carry out measured shovel packing (MSP)

Identify location and type of defect

- Using the Track Recording Vehicle trace, or supervisor's instruction etc, identify location and type of defect.
- Mark up start and end of site from high spot to high spot. This must be marked clearly on the sleepers when using scoping form as you may not be the one delivering the work.

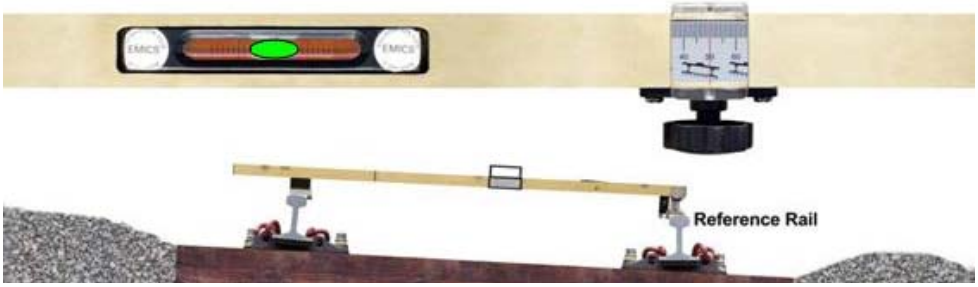
Take datum and rail temp readings

- Measure the six foots every 10m (30 feet) - or if there is no nearby track, take dimensions to a suitable fixed point and mark this on the rail.
- Take rail temp readings.

Select Reference Rail

The reference rail will be the rail which requires the least amount of lift.

- For straight track – this is the rail with the most consistent top
- For canted track - Set the cross level to designed cant. If the bubble is at zero, then the reference rail is the low rail. If the bubble is not at zero, the reference rail is the rail which the bubble is closest too.

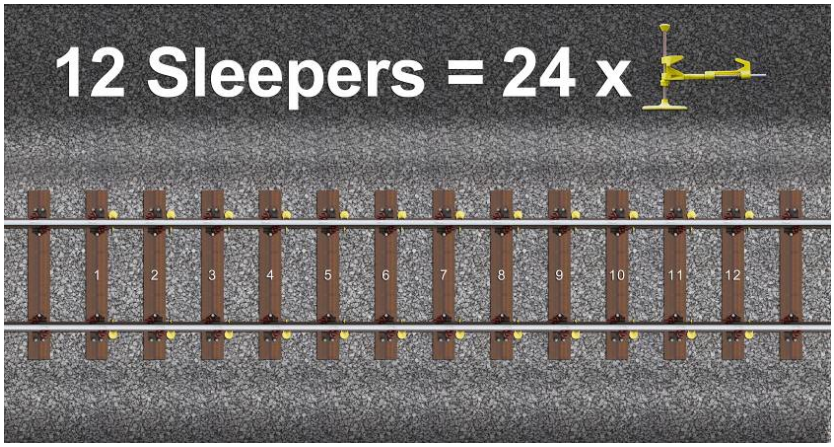


Track Work Information Sheet 2T007
How to carry out measured shovel packing (MSP)

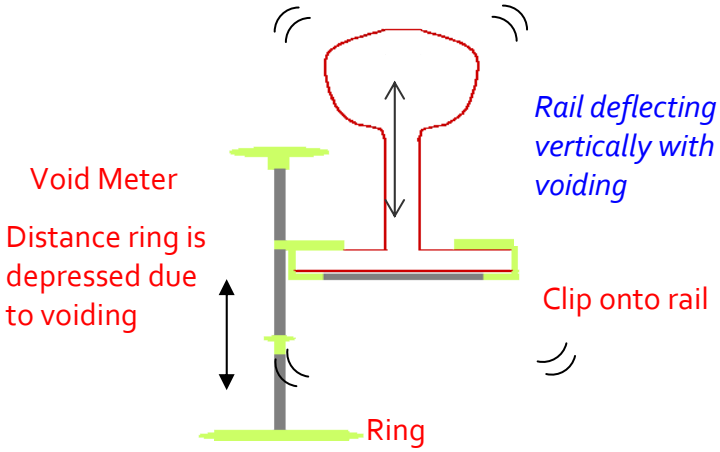
Place Void Meters and Take Void Readings

Void meters should be placed throughout the worksite for every voiding sleeper as it cannot be assumed the voids are constant. Never measure the voiding of different ends of a sleeper with different trains. 24 void meters will measure the voids across 12 sleepers on both rails.

Place the void meters as close to the sleepers as possible, without touching them.



- Allow a train to pass over the site and watch the voiding.
- Cross Level measurements can be taken whilst waiting for a train.



- Use a step gauge to measure the distance the ring is depressed to give you your void reading in mm and mark this reading on the web of the rail or on the scoping form.

Track Work Information Sheet 2T007
How to carry out measured shovel packing (MSP)

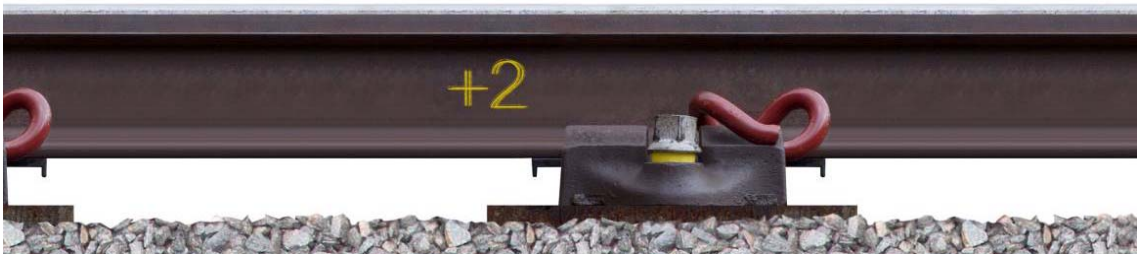
Once the void readings have been taken, remove void meters and store away.

Take Cross Level Readings

These readings enable top and twist faults to be resolved. The lifts measured are for the non reference rail to bring it back up to the design cant of the track.

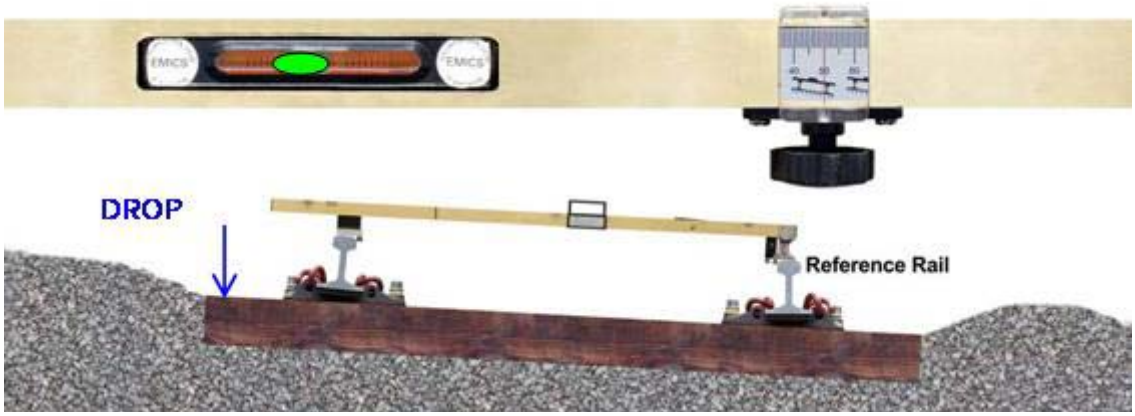
- Cross level readings are taken at every sleeper across the site.
- Set the cross level gauge to the cant of the track.
- If the bubble of the gauge **moves towards** the reference rail, a positive lift is needed.

- The required lift is given by the reading on the gauge. Mark the positive lift value either on the web of the non reference rail or preferably on the scoping form.

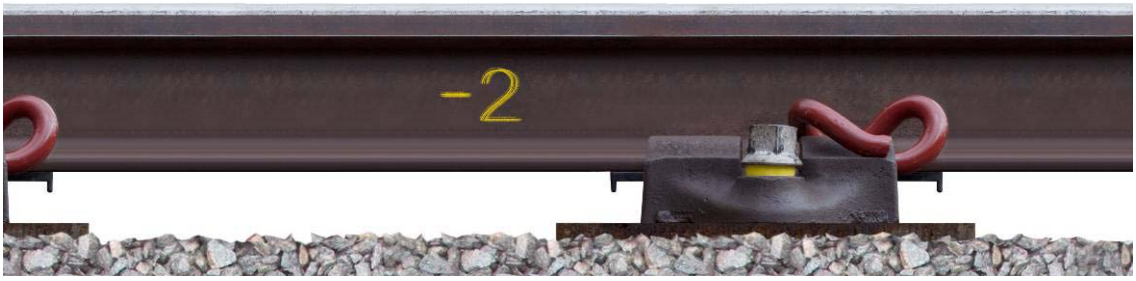


Track Work Information Sheet 2T007
How to carry out measured shovel packing (MSP)

- If the gauge bubble **moves away** from the reference rail, then a negative lift (drop) is required.

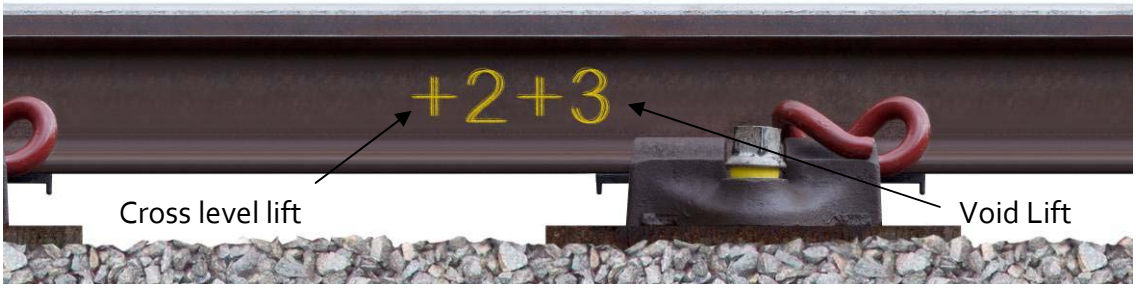


- The required drop is given by the reading on the gauge which is indicated by the use of a negative sign. The drop value can be marked on the web of the non reference rail or preferably on the scoping form.



There should be minimal drops required; otherwise the choice of reference rail is incorrect.

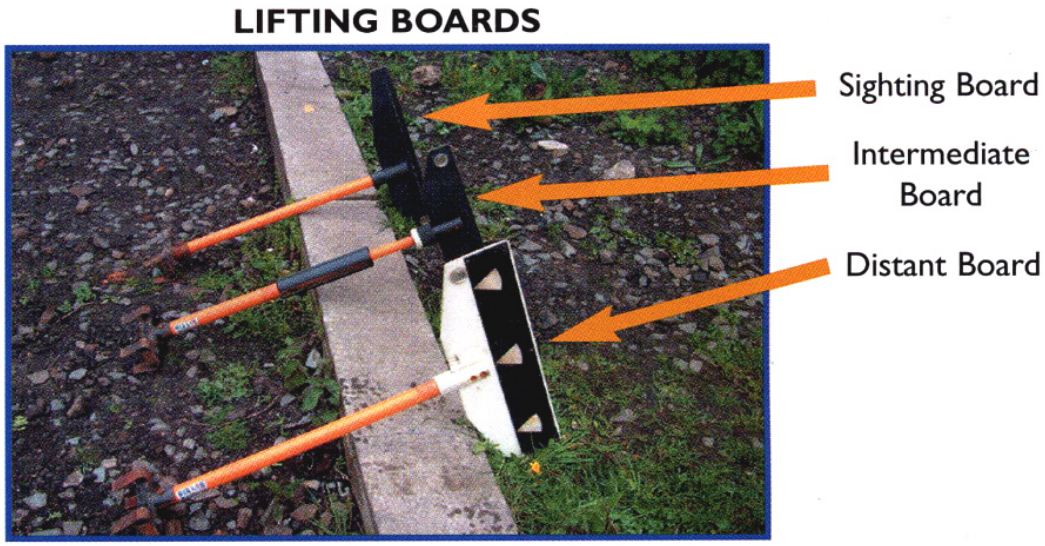
You should now have two readings either on the non reference rail or scoping sheet;



Track Work Information Sheet 2T007
How to carry out measured shovel packing (MSP)

Select High Spots and Set out Sighting Boards

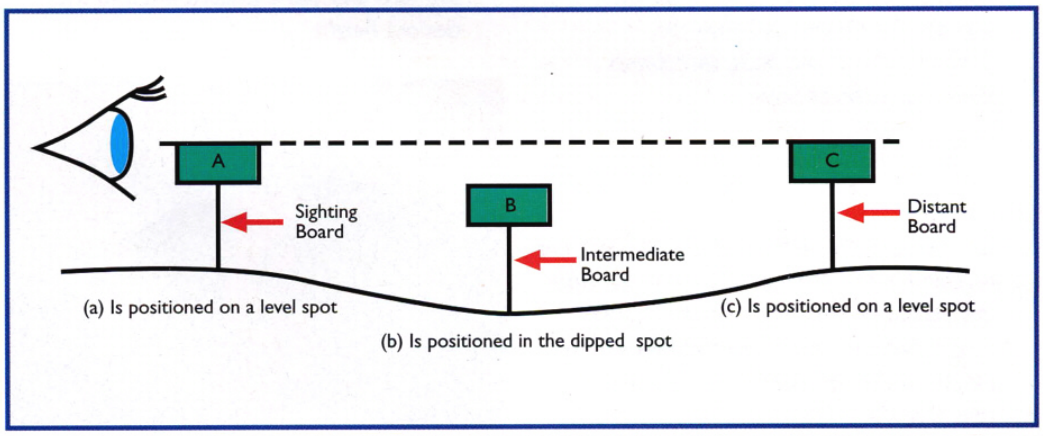
Sighting boards are used to measure top faults along the reference rail. Lifts measured will be used to lift both rails to avoid creating any twist faults and create a good top for both rails.



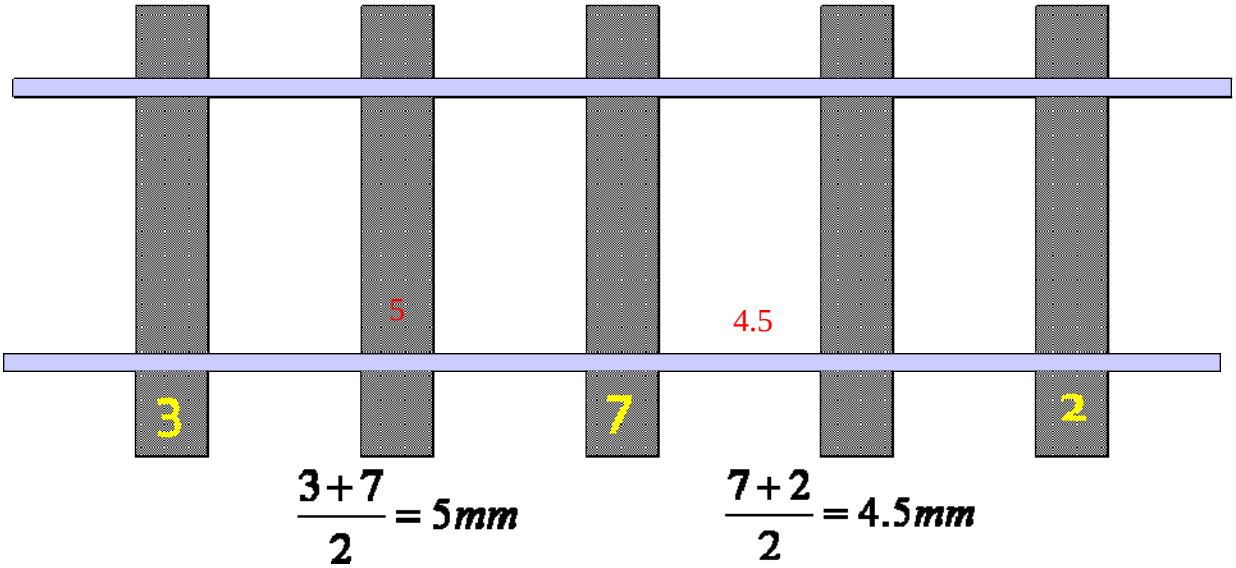
The worksite may have more than one dip and therefore more than two high spots. You should work from high spot to high spot – there will be one worksite per dip.

- The sighting board is placed on the reference rail at the start of the worksite on a high spot.
- The target board is placed at the next high spot. This should not be more than 36 metres away from the sighting board.
- The intermediate board is positioned between the sighting and target boards, starting next to the sighting board.
- Set the intermediate board to zero on the adjustable collar.
- Look through the bottom of the slot in the sighting board whilst an operative raises the intermediate board to line up all three sighting edges.

Track Work Information Sheet 2T007
How to carry out measured shovel packing (MSP)



- The level indicated on the scale of the intermediate board's adjustable collar is the lift required.
- Mark these values on the rail.
- Move the intermediate board on two sleepers and repeat the measurement process.
- Once the target board has been reached, go back through and work out the lift required for the intermediate sleepers, by adding the measured lift values from the adjoining sleepers together and divide by 2 (see below). If the reading is not a whole number simply round it up, in this example 4.5 will become 5.



Track Work Information Sheet 2T007
How to carry out measured shovel packing (MSP)

Calculate Total Lift, first in mm and then converted to number of cans.

Reference Rail Lifts

- Add together the void meter readings and the sighting board readings, divide the result by 2 and mark in a circle on the rail web or on the scoping form.

Non Reference Rail Lifts

- Add together the cross level readings, void meter readings and the sighting board readings from the reference rail, divide the result by 2 and mark in a square on the rail web or scoping form.

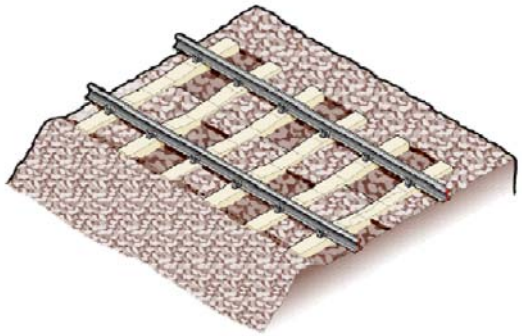
This process will give you the total lifts in cans for each sleeper. A can of chippings gives a 2 mm lift.

Track Work Information Sheet 2T007
How to carry out measured shovel packing (MSP)

Delivery

Dig out sleeper bays

- Dig out alternate cribs a shovel and a half width either side of the rail, down beneath the bottom of the sleeper. This allows the packing of two sleepers at a time.



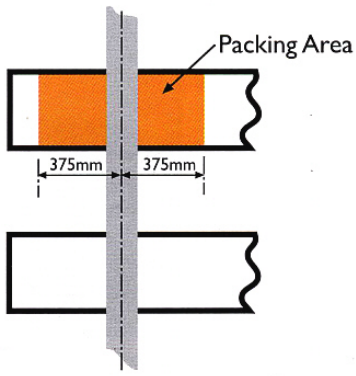
Jack the Rail

- When working red zone jack both rails at the same time. If working green zone rails can be lifted independently. Make sure that there is enough room under the sleepers to get the swan neck shovel and chippings under the whole width of the sleeper.

Pack the Sleepers

- Place the chippings onto the swan neck shovel and then pack under the sleeper.

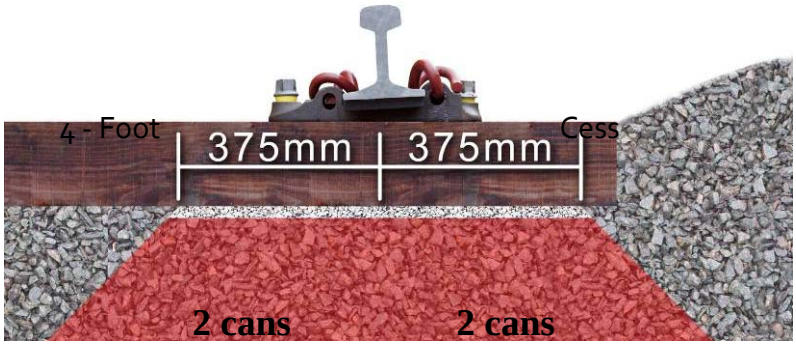
Continually move the shovel in and out from under the sleeper, to get an even distribution of the chippings (375 mm) either side of the rail.



The amount of cans is split evenly and placed under the sleeper either side of the rail.

Track Work Information Sheet 2T007
How to carry out measured shovel packing (MSP)

Example: If you require 4 cans (8 mm) of lift, pack 2 cans of chippings cess side then 2 cans 4-foot side. This will give you an even 4 can lift of the sleeper end.



Lower the Rail

- Once the sleepers have been packed either side of the jack, lower the jack and move to the next jacking point.

- Jack the rail up and pack the next set of sleepers following the same process until all sleepers have been packed as required throughout the worksite.

Measure and check

- Use the cross level gauge to check the cross levels throughout the site, making sure that no twist faults have been introduced and use the datum points to ensure the track has not slued during the lift.

Fill in the bays

- When you are confident that the fault has been rectified, fill in the bays / box in and re-profile the ballast shoulder, making sure of sufficient ballast levels.

Check

Check during and after bedding in period

- After disturbing the ballast you must check the site, after the required bedding in period which should be no more than 2/3 days dependant upon traffic.
- Even after a train or two you can expect top and cross level errors as the ballast will settle unevenly especially where there was a difference in cross level prior to treatment.
- The opportunity to correct early settlement should be taken.