Justification: Safety

(Maintenance)

Private Owner Circular Letter 484 - Issue 4

Title:

Measurement of Frame Twist and Wheel Loads on Two-Axle Wagons

Authorised by:

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1. INTRODUCTION

POCL 484, Issue 4 has been produced to highlight the fact that if cone packings are used to compensate for frame twist then the only method of checking is by measuring the vertical wheel loads. This is because the cone packing method, whilst correcting the vertical wheel loads, does not compensate the frame twist itself. In addition it highlights the need to average the heights of suspension scroll irons or brackets at each corner of non-pedestal suspensions.

2. WHEN TO CHECK FOR FRAME TWIST (OR VERTICAL WHEEL LOAD DISTRIBUTION)

All two-axle wagons shall be checked for frame twist (or vertical wheel load distribution) when:

a). A new wagon is built, and before any suspension components or brackets are attached.

b). A period of seven years has passed since the previous frame twist check.

Note: This period may exclude periods of long-term storage with the wagon out of operational service, if agreed by Network Rail's Senior PWRA Engineer.

c). A wagon is involved in a derailment.

d). A wagon is involved in a collision with buffer stops, other vehicles or similar obstructions, (except as experienced through normal railway operations).

e). A wagon is involved in any other incident where the wagon is exposed to abnormal frame or suspension loads which may cause distortion to the underframe or suspension components.

f). A wagon's body is removed or extensive welding repairs are carried out on the underframe, solebar or body.

g). A visual inspection at maintenance indicates the frame may be twisted.

h). Frame twist compensation packing shims or cone packings have just been fitted to compensate for frame (as a check).

i). A wagon regularly records abnormal Wheelchex cross-axle loads when compared to other wagons of the same design and utilisation.

A frame twist measurement record sheet is enclosed in this POCL for use if required.

3. MAXIMUM PERMISSIBLE UNCOMPENSATED FRAME TWIST

The maximum permissible uncompensated frame twist measured at or near to the axle centres are as follows:

Wagon category	Maximum Twist
New wagons with laminated spring suspensions	3mm
New wagons with parabolic spring suspensions	3mm
New wagons with pedestal suspensions	2mm
All other wagons (i.e. existing wagons in service)	6mm

4. REMEDIAL REQUIREMENTS WHERE FRAME TWIST EXCEEDS PERMISSIBLE LIMITS

a) For new wagons, frame twist shall be compensated for before any suspension components or brackets are attached, with all compensation packers being incorporated into the permanent wagon structure, e.g. by tack welding.

b) On wagons in service, either:

i) Suitable compensation packing shims shall be fitted to compensate for the frame twist, noting that if the amount of compensation packing required exceeds 12mm it shall be divided equally between the diagonally opposite corners of the wagon, and that under no circumstances shall the thickness of packers at any one corner of a wagon exceed 15mm. (See Section 5. for the location and minimum thickness of compensation packers).

or

ii) On wagons fitted with link suspensions and a spigot location in the axlebox, an appropriately thicker cone block may be fitted as shown in Drawing No. RCH 3134. Such a cone block when fitted at the high corner will compensate for frame twist. On wagons compensated in this way a plate giving details of the additional thickness shall be permanently fixed to the solebar of the wagon, immediately above the axlebox concerned. When springs are changed on a wagon compensated in this way, it shall be ensured that any compensating cone packers are replaced at the correct position. Similarly, following wheelset exchange or wheel re-profiling the suspension height may need to be adjusted, and care shall be taken to ensure that any additional amount of packing required to compensate for frame twist is included at the correct position. Any wagon found with cone blocks of unequal thickness but without a plate giving details of the additional thickness shall be removed from service and the matter investigated.

c) On wagons in service, the underframe shall be carefully examined to confirm that there is no distortion and that there are no fractures present.

d) When a wagon has been fitted with frame twist compensation packings either between the solebar flange and the suspension shoe/bracket, between the suspension bracket and auxiliary suspension unit or between the solebar flange and pedestal assembly, a white letter 'Q' 25mm high shall be painted on the solebar adjacent to the compensation packing.

e) Following compensation for frame twist, a repeat frame twist check shall be carried out to verify that the identified twist has been compensated for correctly.

f) Following compensation for frame twist, the buffer heights and suspension clearances shall be examined to ensure they are within acceptable limits.

5. LOCATION AND MINIMUM THICKNESS OF PACKERS FOR EXISTING WAGONS

The location and minimum thickness of packers for existing wagons are as tabled below and as illustrated in Figures 3 to 6.

Suspension Type	Location of Packing	Minimum Thickness	Figure
Single Link	Between solebar and scroll iron	6mm	4
Double Link	Between solebar and scroll iron	6mm	5
UIC Double Link	Between welded bracket and solebar	10mm	6
Pedestal Type	Between pedestal casting and solebar	6mm	7

6. TRACK GEOMETRY REQUIREMENT FOR FRAME TWIST MEASUREMENT (OR VERTICAL WHEEL LOAD DISTRIBUTION)

The measurement of frame twist (or vertical wheel load distribution) shall only be carried out on reasonably level track, where the difference in height of one rail relative to the other shall be measured at the positions of the wagon's two axles. The variation between the cross levels at these positions shall not exceed 6mm if the cant at both ends of the wagon is in the same direction, or 3mm if the cants are in opposite directions.

7. MEASUREMENT OF VERTICAL WHEEL LOADS

If cone packings are fitted to equalise the wheel loads resulting from any frame twist, then measurement of vertical wheel loads is the only method of checking that shall be used.

Vertical wheel load measurements shall be taken with the wagon stationary and in the tare condition. Care shall be taken to ensure that any friction in the suspension does not unduly affect the measurements. The system and process for measuring vertical wheel load distribution shall be approved by Network Rail's Senior PWRA Engineer.

Note: Any wagon may be checked for vertical wheel load distribution using a rail wheel weighing system and process as an alternative to measuring frame twist.

7.1 Limit of cross-axle wheel load differential

The maximum permissible cross-axle wheel load differential shall be 0.5 tonnes on each axle with a wagon measured in the tare condition.

7.2 Remedial requirements where cross-axle wheel load differentials exceed permissible limits

Any wagon that fails to comply with the cross-axle wheel load differential check shall be examined to identify why the individual corner loads are not within the prescribed limits. Where defects are identified and rectified, the cross-axle wheel load differential check shall be repeated to verify that the wagon is subsequently within the prescribed limits and that the remedial repair work has been successful. In cases where it is either not possible to identify any faults, or remedial repairs do not correct the cross-axle wheel loads adequately, the Owner shall consult with Network Rail's Senior PWRA Engineer for further advice.

8. MEASUREMENT OF FRAME TWIST

The method of measuring frame twist is not mandated, though the following optical level measuring method is recommended, given its relative simplicity, adequate accuracy, and the ready availability of suitable measuring devices.

Note: Measurement of frame twist shall not be used where cone packings are fitted.

8.1 Tools and training:

The Optical Level Instrument shall be suitable for short range measurement and the user shall be trained in the use of the instrument and procedures for this specific application.

To enable the check to be carried out by one person, a measuring staff can be used. Such a staff should be approximately 300mm long and constructed so that it may be readily clamped to the underside of the solebar at the vertical height of the suspension attachments, or upper face of the pedestal casting on pedestal suspensions. Alternatively, if a second person is available, a simple measuring staff such as a steel rule may be held in the same position for the measurements.

8.2 Optical measurement procedure for wagons fitted with non-pedestal suspensions

The following method shall be used when measuring frame twist:

a) Identify the sighting points from Figure 2 and the axlebox type from Figures 4 to 6.

b) Clean off any rust, scale, or paint accumulations etc., for location of the measuring staff.

c) Note on any wagon previously fitted with compensation packing shims, the measuring datum is the underside of the packing shims.

d) Set up optical level instrument in accordance with manufacturer's instructions at sighting point 'A' (see diagram on record sheet – Appendix 1), approximately 4m from wagon and close to the wagon's centre.

e) Secure measuring staff to the underside of the solebar at Corner 1 adjacent to the outer suspension mount. Take reading and enter on record sheet.

f) Secure measuring staff to the underside of the solebar at Corner 1 adjacent to the inner suspension mount. Take reading and enter on record sheet.

g) Calculate and record the average of the inner and outer suspension mount measurements.

h) Transfer measuring staff to Corner 2, and repeat measurements/calculation as per e), f) and g).

i) To ensure there has been no movement of the optical instrument, transfer the measuring staff back to Corner 1 and check the readings.

j) Move optical level instrument to sighting point 'B' (see Figure 2).

k) Transfer measuring staff to Corner 3 and repeat measurements/calculation as per e), f) and g).

l) Transfer measuring staff to Corner 4 and repeat measurements/calculation as per e), f) and g).

m) To ensure there has been no movement of the optical instrument, transfer the measuring staff back to Corner 3 and check the readings.

n) Add together the readings at Corners 1 & 3.

o) Add together the readings at Corners 2 & 4.

p) Calculate the difference between the total of 'n' above and 'o' above. This difference is the relative frame twist of diagonal (1) and (3) to (2) and (4).

q) It is essential that readings are taken on the measuring staff with the scale reading upwards i.e. the scale should have the lowest number at the bottom.

r) Packing shims will be required on the diagonal which has the lower sum of corner readings, i.e. either 1 & 3 or 2 & 4 in cases where the difference is greater than 6mm. If the packing thickness required is 12mm or more, it shall be divided between the diagonal corners of the wagon. Having determined the corner of the wagon which requires packing, the methods and locations of packing, for various types of suspension, are listed in Section 5.

s) The thickness of packing fitted at any one corner of a wagon shall not exceed 15mm without the prior approval of Network Rail's Senior PWRA Engineer.

8.4 Optical measurement procedure for wagons fitted with pedestal suspensions (Figure 7)

The following method shall be used when measuring frame twist:

a) Identify the sighting points from Figure 3.

b) Clean off any rust, scale, or paint accumulations etc., for location of the measuring staff.

c) Note on any wagon previously fitted with compensation packing shims, the measuring datum is the underside of the packing shims.

d) Set up optical level instrument in accordance with manufacturer's instructions at sighting point 'A' (see diagram on record sheet – Appendix 2), approximately 4m from wagon and close to the wagon's centre.

e) Secure measuring staff to the underside of the solebar at Corner 1 adjacent to the suspension mount. Take reading and enter on record sheet.

f) Transfer measuring staff to Corner 2, and repeat measurement as per e).

g) To ensure there has been no movement of the optical instrument, transfer the measuring staff back to Corner 1 and check the reading.

h) Move optical level instrument to sighting point 'B' (see Figure 3).

i) Transfer measuring staff to Corner 3 and repeat measurement as per e).

j) Transfer measuring staff to Corner 4 and repeat measurement as per e).

k) To ensure there has been no movement of the optical instrument, transfer the measuring staff back to Corner 3 and check the reading.

l) Add together the readings at Corners 1 and 3

m) Add together the readings at Corners 2 and 4

n) Calculate the difference between the total of 'l' above and 'm' above. This difference is the relative frame twist of diagonal (1) and (3) to (2) and (4).

o) It is <u>essential</u> that readings are taken on the measuring staff with the scale reading upwards i.e. the scale should have the lowest number at the bottom.

p) Packing shims will be required on the diagonal which has the lower sum of corner readings, i.e. either 1 & 3 or 2 & 4 in cases where the difference is greater than 6mm. If the packing thickness required is 12mm or more, it shall be divided between the diagonal corners of the wagon. Having determined the corner of the wagon which requires packing, the methods and locations of packing, for various types of suspension, are listed in Section 5.

q) The thickness of packing fitted at any one corner of a wagon shall not exceed 15mm without the prior approval of Network Rail's Senior PWRA Engineer.

9. RECORDS

The latest record from any frame twist check (or measurement of vertical wheel loads) shall be retained until it is superseded by a subsequent periodic or incident based check.

Where either existing compensation shims (or similar) are identified during frame twist checks or where the results of frame twist checks reveal the need to fit compensation shims (or similar), the amount of frame twist compensation found or required shall be recorded.

10. SCOPE

This instruction shall be applied to all two-axle wagons registered under the PWRA.

11. IMPLEMENTATION

This POCL shall be implemented from the date of issue.

In the event of any query arising, or clarification required, please contact:

Senior PWRA Engineer
PWRA Management Group
Room 207 Derwent House
rtc Business Park
London Road
Derby
DE24 8UP

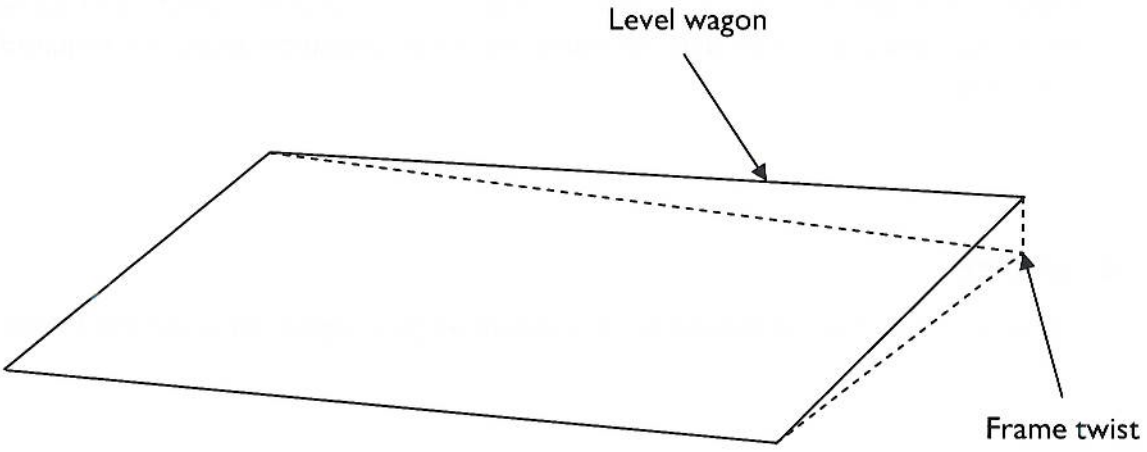

Figure 1 – Illustration of Frame Twist

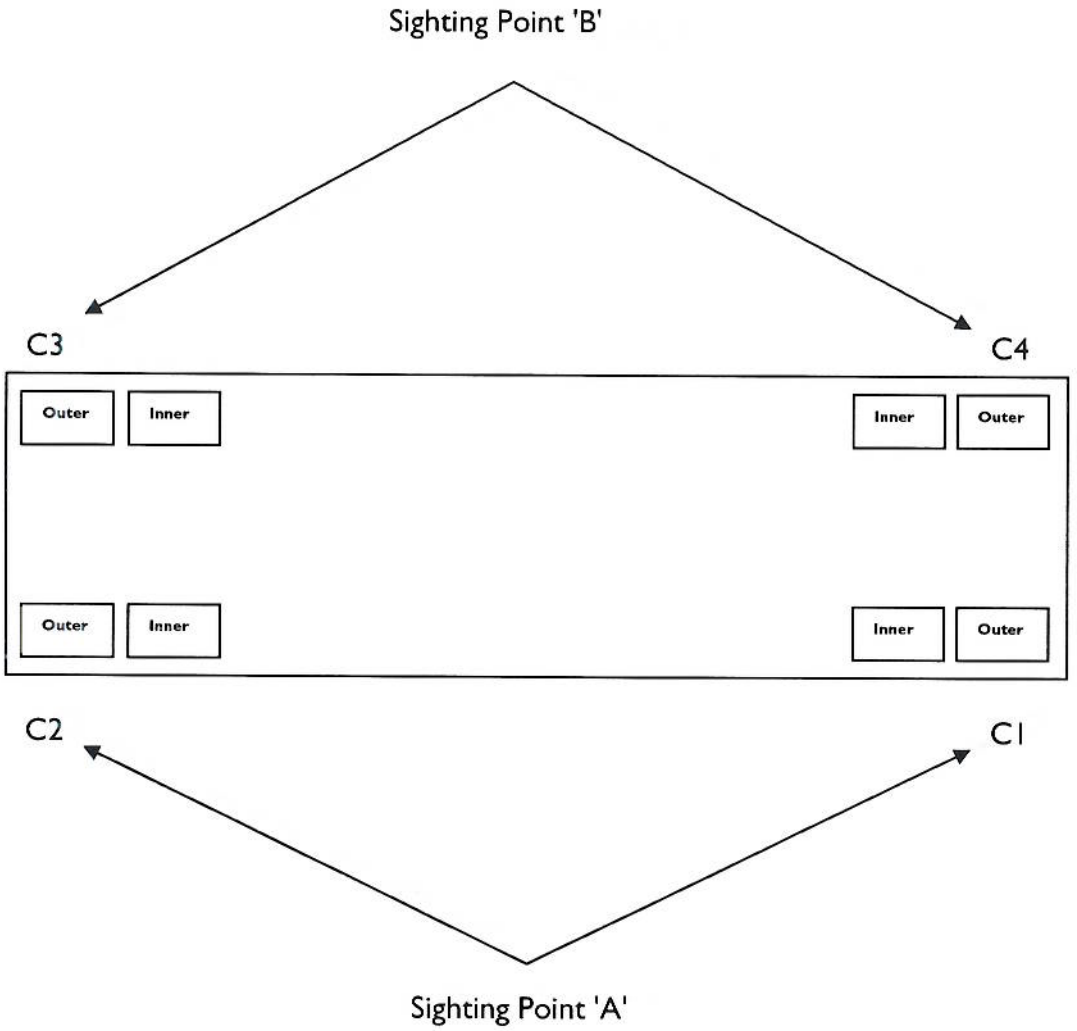

Figure 2 – Position of sighting points for wagons with non-pedestal suspensions

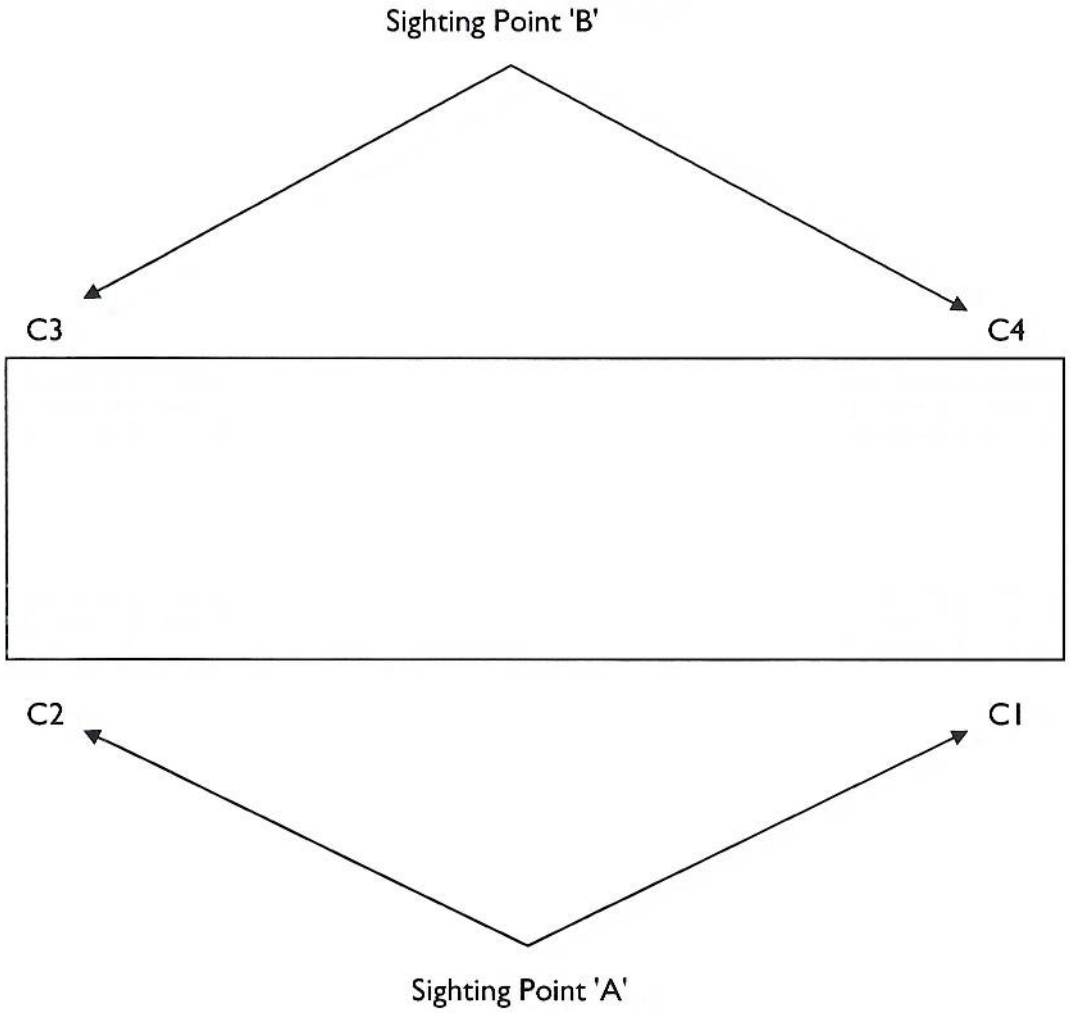

Figure 3 – Position of sighting points for wagons with pedestal suspensions

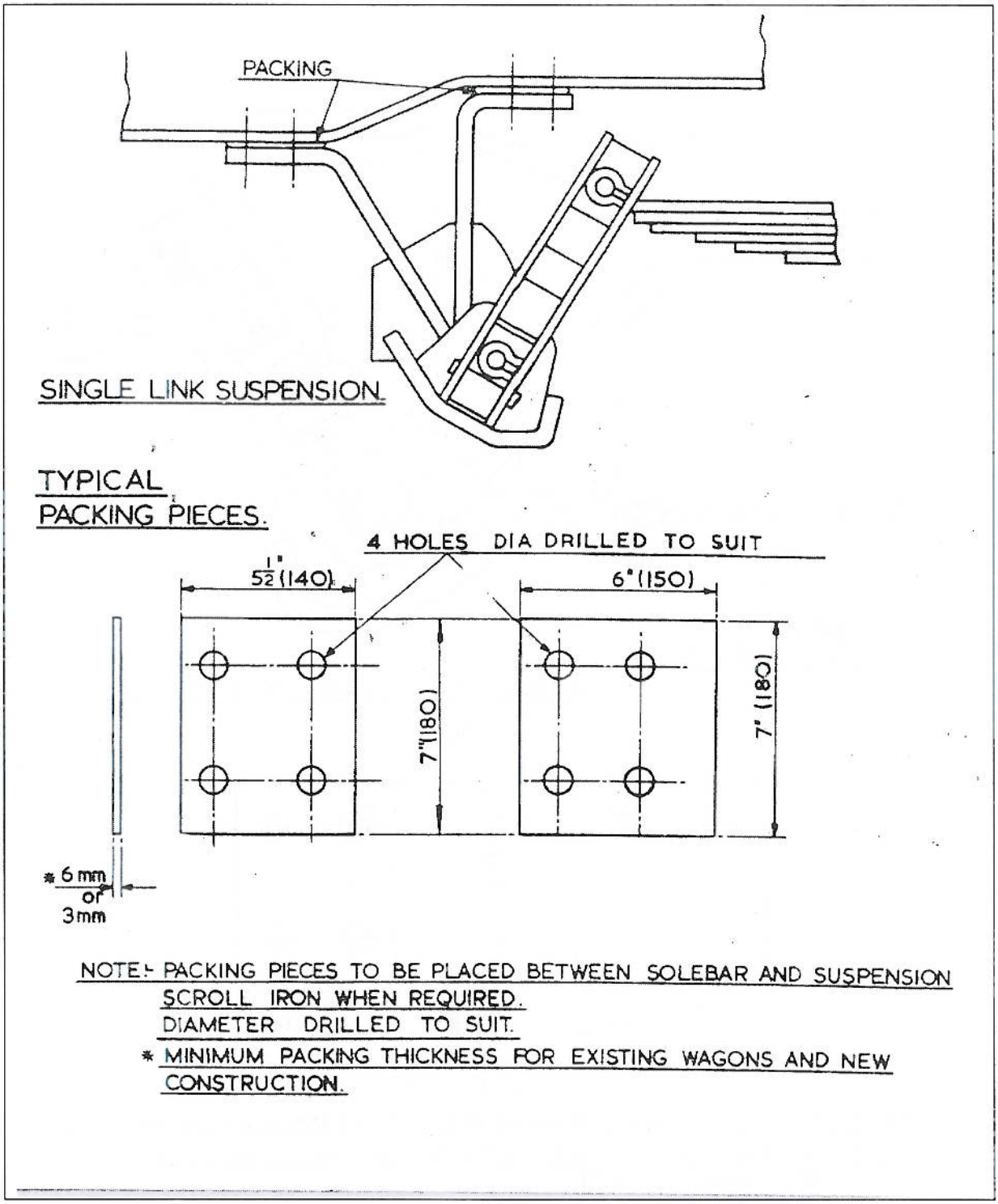

Figure 4 Packing location for Single Link Suspension

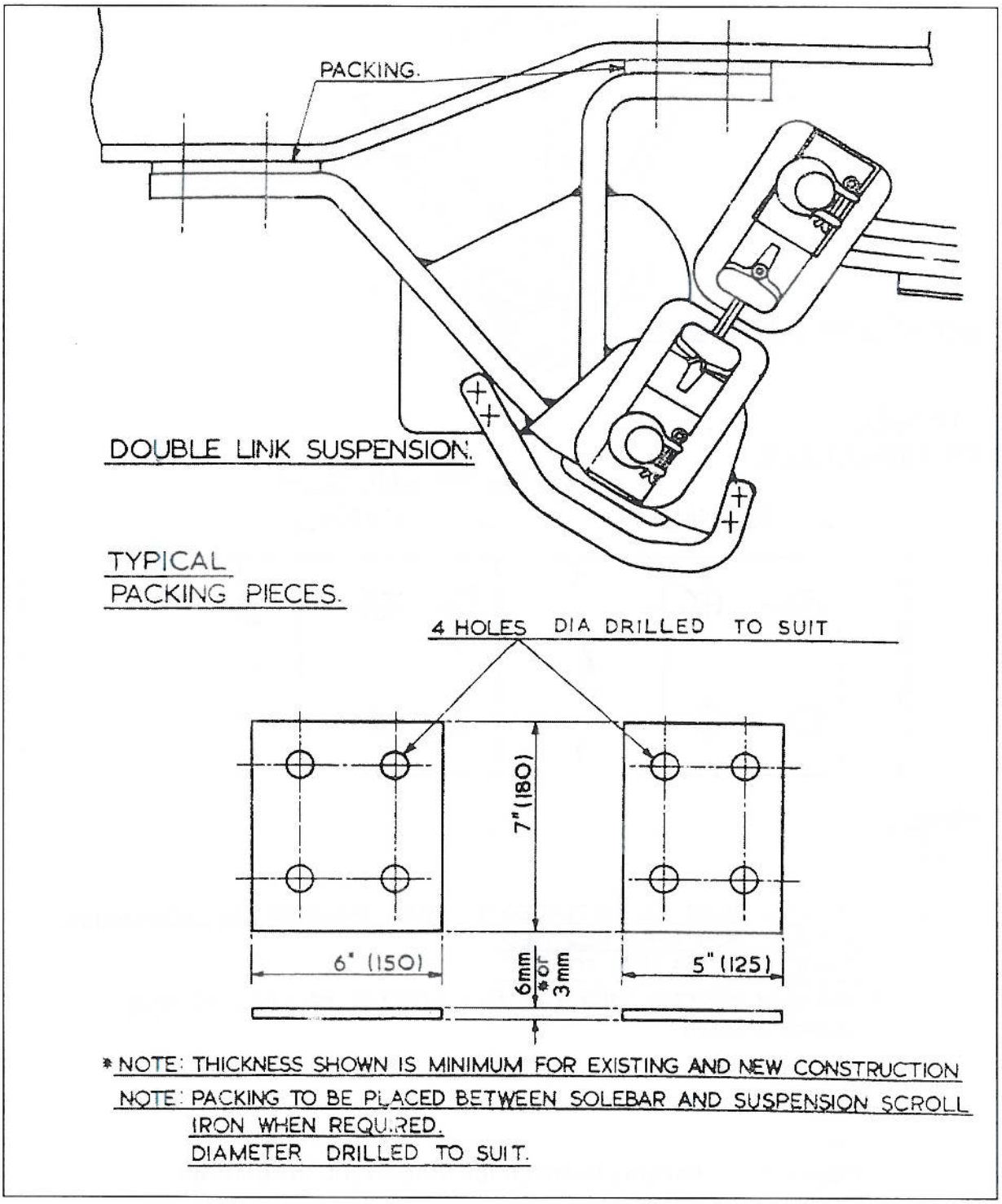

Figure 5 Packing location for Double Link Suspension

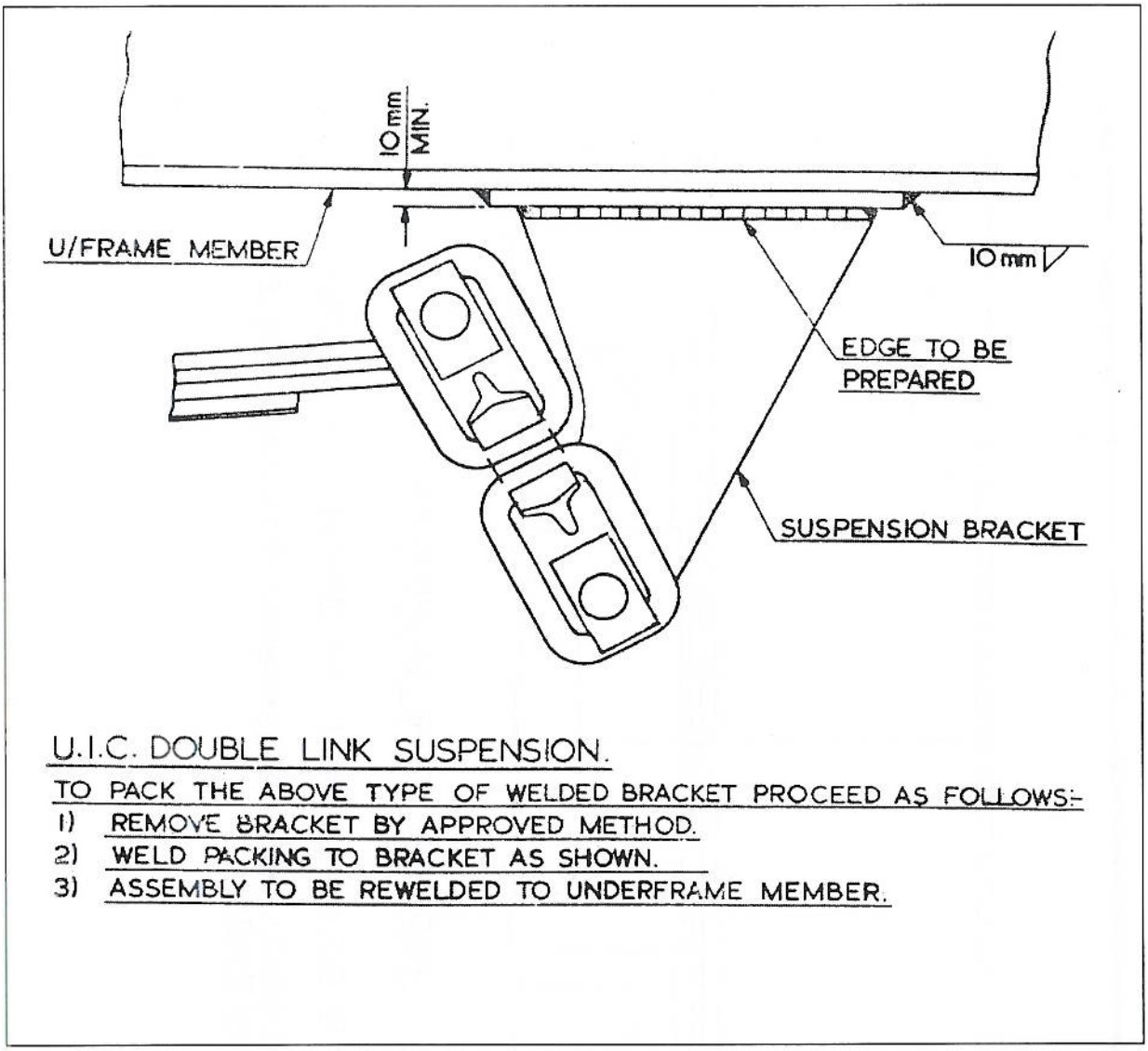

Figure 6 Packing location for UIC Double Link Suspension

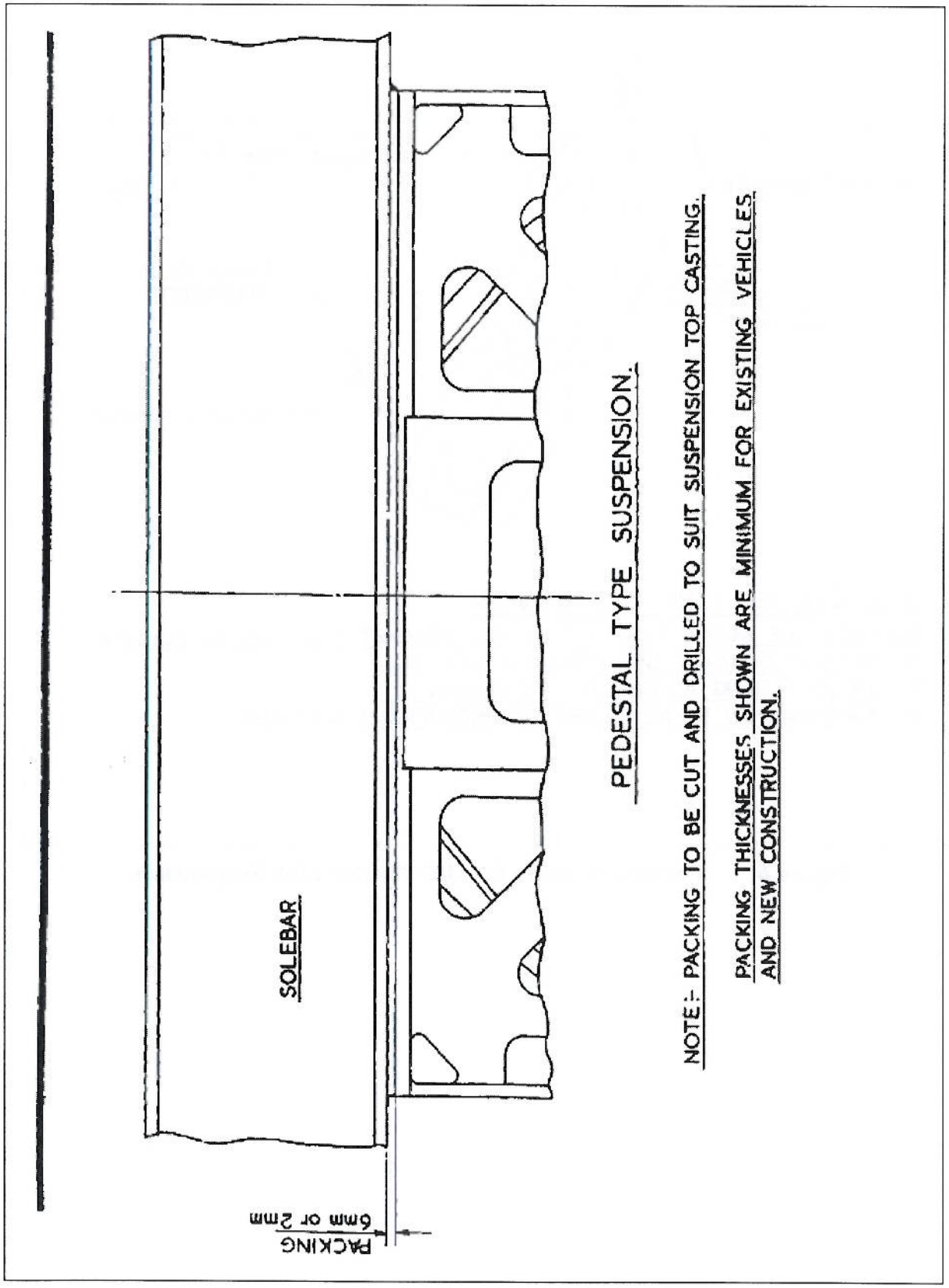

Figure 7 **Packing location for Pedestal Type Suspension**

Appendix 1

Frame Twist – Measurement and Compensation Packing Record Sheet for Wagons fitted with Non-Pedestal Suspensions

Wagon No. ..... Date .....

Owner ..... Location .....

Corner C1	Outer = Inner =	$\frac{\text{Outer + Inner}}{2}$ =	= C1
Corner C2	Outer = Inner =	$\frac{\text{Outer + Inner}}{2}$ =	= C2
Corner C3	Outer = Inner =	$\frac{\text{Outer + Inner}}{2}$ =	= C3
Corner C4	Outer = Inner =	$\frac{\text{Outer + Inner}}{2}$ =	= C4

Corner C1 + Corner C3 = = 'X'
Corner C2 + Corner C4 = = 'Y'

Difference between 'X' and 'Y' = = 'Z'

Packing of thickness 'Z' required at the lower end of the diagonal totals 'X' or 'Y'.

Note: Packing thickness required = 'Z'

0 to 6mm - No packing required.
7mm to 12mm - Pack at one corner.
13mm to 30mm - Divide packing between diagonal corners.

Carried out by: Name ..... Signature .....

Appendix 2

Frame Twist – Measurement and Compensation Packing Record Sheet for Wagons fitted with Pedestal Suspensions

Wagon No. ..... Date .....

Owner ..... Location .....

Corner C1 = = C1

Corner C2 = = C2

Corner C3 = = C3

Corner C4 = = C4

Corner C1 + Corner C3 = = 'X'
Corner C2 + Corner C4 = = 'Y'

Difference between 'X' and 'Y' = = 'Z'

Packing of thickness 'Z' required at the lower end of the diagonal totals 'X' or 'Y'.

Note: Packing thickness required = 'Z'

0 to 6mm - No packing required.
7mm to 12mm - Pack at one corner.
13mm to 30mm - Divide packing between diagonal corners.

Carried out by: Name ..... Signature .....