



Australian Government  
Department of Industry,  
Innovation and Science

## National Measurement Institute

### Certificate of Approval

**NMI 6/14H/5**

Issued by the Chief Metrologist under Regulation 60  
of the  
National Measurement Regulations 1999

This is to certify that an approval for use for trade has been granted in respect of the instruments herein described.

Railweight Model Weighline TSR4000 Train Weighing-In-Motion Instrument

submitted by      Downer EDI Engineering Power Pty Ltd  
480 Victoria Road  
GLADESVILLE    NSW    2111

**NOTE:** This Certificate relates to the suitability of the pattern of the instrument for use for trade only in respect of its metrological characteristics. This Certificate does not constitute or imply any guarantee of compliance by the manufacturer or any other person with any requirements regarding safety.

This approval has been granted with reference to document NMI R 106, *Automatic Rail Weighbridges*, dated July 2004.

This approval becomes subject to review on **1/09/22**, and then every 5 years thereafter.

#### DOCUMENT HISTORY

Rev	Reason/Details	Date
0	Pattern provisionally approved – interim certificate issued	2/04/09
1	Pattern approved – interim certificate issued	8/09/09
2	Pattern & variant 1 approved – certificate issued	14/10/09
3	Pattern & variant 1 amended (pattern & Test Procedure) – notification of change issued	22/10/10
4	Pattern & variant 1 amended (Test Procedure), variant 2 approved – certificate issued	5/05/11
5	Variants 3 & 4 provisionally approved – interim certificate issued	8/03/13
6	Variants 3 & 4 amended (validity date) – interim certificate issued	6/05/13

Document History (cont...)

Rev	Reason/Details	Date
7	Pattern amended, pattern & variants 1 to 3 <b>reviewed</b> , variant 4 approved - certificate issued	30/08/17
8	Variant 4 amended - certificate issued	24/04/18

## CONDITIONS OF APPROVAL

### General

Instruments purporting to comply with this approval shall be marked with approval number 'NMI 6/14H/5' and only by persons authorised by the submitter.

It is the submitter's responsibility to ensure that all instruments marked with this approval number are constructed as described in the documentation lodged with the National Measurement Institute (NMI) and with the relevant Certificate of Approval and Technical Schedule. Failure to comply with this Condition may attract penalties under Section 19B of the National Measurement Act and may result in cancellation or withdrawal of the approval, in accordance with document NMI P 106.

Auxiliary devices used with this instrument shall comply with the requirements of General Supplementary Certificates No S1/0/A or No S1/0B.

This approval shall NOT be used in conjunction with General Certificate No 6B/0.

### Special Conditions of Approval:

For this type of instrument, the ability to perform (and continue to perform) within specified maximum permissible errors can depend substantially on characteristics of the rail alignment and the stability of the material on which the rail sleepers rest (whether ballast, concrete footings or some other arrangement). However the National Measurement Institute is unable to clearly define particular requirements for material on which the rail sleepers shall rest.

It is the responsibility of the submitter to exercise control over any installation to ensure compliance with this approval and to ensure performance (and continued performance) within the appropriate maximum permissible errors.

The ability to perform within specified maximum permissible errors can also depend on characteristics of the rail vehicles being weighed (for example wagons with 'flat wheels', rubbing brakes or stiff couplings can be detrimental to performance). Consequently rail operators have a responsibility to ensure adequate maintenance of the rail vehicles (otherwise maximum permissible errors may not be able to be met).

In the event of unsatisfactory performance, allowable accuracy classes or modes of operation may need to be altered, additional conditions imposed or this approval may be withdrawn.

### Special Conditions of Approval: (Provisional approval – variants 3)

This approval is limited to one (1) instrument the location of which is to be advised to NMI prior to any installation or verification of the instrument.

The instrument purporting to comply with this approval shall be marked with approval number 'NMI P6/14H/5' and only by persons authorised by the submitter. (Note: The 'P' in the approval number may be a temporary marking.)

The approval will remain provisional pending completion of satisfactory testing and evaluation.

The submitter shall provide NMI with copies of test results from the initial verification and all subsequent tests.

In the event of unsatisfactory performance, or of suitable test results not being received by NMI the approval may be cancelled (or altered).

The submitter shall implement such modifications as required by NMI. In the event that such modifications (if any are required by NMI) are not made to the satisfaction of NMI prior to the dates agreed, this approval may be withdrawn.

Instruments shall be verified annually.

Signed by a person authorised by the Chief Metrologist  
to exercise their powers under Regulation 60 of the  
*National Measurement Regulations 1999*.



**Darryl Hines**

Manager  
Pattern Approval, Policy and  
Licensing Section

## TECHNICAL SCHEDULE No 6/14H/5

### 1. Description of Pattern

**provisionally approved on 2/04/09  
approved 8/09/09  
amended 30/08/17**

A Railweight model Weighline TSR4000 weighing instrument for the determination (by measurement of wheel forces) of the mass of wagons and hence the total mass of a train, when weighed in motion. The instrument is approved for class 2 wagon weighing and class 1 or 2 train weighing, with a maximum wagon weight of up to 135.4 t, and a scale interval of at least 200 kg, over a speed range of 0.1 to 80 km/h.

#### 1.1 The System

The Weighline TSR4000 system includes eight Railweight model WEIGHLINE RWT-X TR60 weighing transducers, five Tiefenbach model 2N59-1R-200-40 double wheel sensors and a Railweight model Weighline TSR4000 weight processor.

The weighing system is powered by an uninterruptible power supply.

The weighing system utilises a model LM35 semi-conductor type temperature sensor for measuring the temperature of the rails.

#### 1.2 Weighing Transducers

Eight (8) Railweight model WEIGHLINE RWT-X TR60 weighing transducers (Figure 1a) mounted in pairs on adjacent rails. Figure 2 shows only 2 pairs of transducers – the additional 2 pairs are out of view. The rails are mounted on sleepers. Each transducer has a number of strain gauges bonded to the web of the rail. Each transducer has a maximum capacity of 18 tonne, giving a maximum axle capacity of 36 tonne.

NMI approved load cell protectors are used with each weighing transducer.

#### 1.3 Track Switches

Five (5) Tiefenbach model 2N59-1R-200-40 double wheel sensors are installed and are inductively operated by the wheel flanges of the rail vehicles. The operating sequence provides signals which prevent the locomotive mass from being printed, enable the instrument to determine the type of the wagon being weighed, detect any reversal of train movement, and monitor the speed of the wagons during weighing.

#### 1.4 Indication

A Railweight model Weighline TSR4000 weight processor (Figure 1b) is used. In addition, the weight processor may be connected to a printer and AVI (automatic vehicle identification equipment).

The TSR4000 weight processor comprises:

- A microprocessor board and a multifunction expansion board;
- An analog to digital converter board;
- A system motherboard; and
- A display and keyboard.

When a weighing sequence is commenced, the instrument is zeroed automatically prior to weighing beginning.

The instrument can be connected to a personal computer to gather weights and all status messages from the TSR4000, for transmission to a remote server. This connection is by an RS232 comms link. The printer connection is via a parallel

printer port and the AVI connection can be either RS232 or 4 wire RS422 comms link.

## 1.5 Printer

The printout displays the wagon sequence number, wagon weight, train speed and total train weight. A status column is also used to display a description of the wagon.

If a train 'overspeed' or other error is detected then "INVALID E" is printed in the wagon weight column for the wagon weight where the overspeed or other error was detected then for every wagon thereafter for that train. Additionally, "E !!! Not valid for transaction purposes !!!", is also printed. A sample ticket is shown in Figure 3.

The weighing results may in addition be provided to another computer system for remote downloading and be used for additional reporting/invoicing purposes.

## 1.6 Roll Back detection

The system will stop registering weights when a roll back of wagons occurs. The weighing process is only continued from the point reached before rollback commenced.

## 1.7 Specifications

In-situ performance of the instrument will depend on site conditions and train configuration.

It may therefore be necessary following in-situ testing (and in the light of results obtained) to restrict the range of operation in ways such as:

- Limiting the maximum or minimum wagon weights.
- Limiting the allowable speed range(s).
- A combination of both the above.

Such restrictions shall be marked on the nameplate of the instrument and where operation occurs outside the acceptable range(s), weight values should not be shown and an error message should appear (similar to the current 'overspeed' arrangement).

Instruments may have differing specifications as described above, but shall be within the limits shown in Table 1 below:

TABLE 1

Accuracy class Train weighing	1 or 2
Accuracy class Wagon weighing	2
Maximum axle capacity	36 t per axle
Minimum axle capacity	2.5 t per axle
Scale interval	200 kg
Maximum wagon weight	135.4 t (or less)
Minimum wagon weight	37 t (or more)
Maximum operating speed	80 km/h or less
Minimum operating speed	0.1 km/h or more

## 1.8 Descriptive Markings and Notices

Instruments bear the following basic markings at each location having a weight indication or printing device (the values given are provided as an example only):

Manufacturer's name or mark	Railweight UK
Importer's name or mark	Downer EDI Engineering Power Pty Ltd
Model designation	Weighline TSR4000
Serial number of the instrument	.....
Pattern approval mark	NMI 6/14H/5
Accuracy class	
Train weighing	1 or 2
Wagon weighing	2
Maximum capacity	Max (axle) 36 t
Minimum capacity	Min (axle) 2.5 t
Scale interval	$d = 200 \text{ kg}$
Maximum wagon weight	135.4 t
Minimum wagon weight	37 t
Maximum operating speed	$v_{\text{max}} = 80 \text{ km/h}$
Minimum operating speed	$v_{\text{min}} = 0.1 \text{ km/h}$
Maximum number of wagons	
per train (*)	$n_{\text{max}} \dots\dots\dots$
(*) If less than 60 wagons.	

The markings shall reflect details for which the particular installation has been verified. The maximum and minimum wagon weights and maximum and minimum operating speeds may vary from those shown in the specifications (clause 1.7) but shall be within the limits specified there. For example, the maximum wagon weight will be related to the heaviest reference wagon used; the National Test Procedures *for Automatic rail weighbridges*, and if necessary the National Measurement Institute, should be consulted for guidelines regarding this.

Note: It is acceptable for more complex sets of markings to be provided. This may be necessary where (for example) it was necessary following in-situ testing to restrict operation to one speed range for wagon weighing and another speed range for train weighing. Such arrangements shall be clearly set out in the markings provided.

## 1.9 Verification Provision

Provision is made for the application of a verification mark.

## 1.10 Sealing Provision

Provision is made for the calibration adjustments in the indicator to be sealed by means of a seal and sealing wire through holes in the rear panel of the Railweight model Weighline TSR4000 indicator.

## 2. Description of Variant 1

approved on 14/10/09

Certain other versions of the Weighline TSR4000 weighing instrument which are the same as the pattern except as described below:

- With three (3) double wheel sensors; and/or
- With four (4) weighing transducers (as shown in Figure 2) and a speed range of 0.1 to 10 km/h.

### 3. Description of Variant 2

**approved on 5/05/11**

The Railweight model Weighline TSR4000 using an alternative processor card (Advantech PCI-6873) and power supply module (Enhance 200W micro ATX). These changes are not visible externally to the TSR4000.

Note: An uninterruptible power supply as mentioned in clause 1.1 **The System** in Technical Schedule is still required.

### 4. Description of Variant 3

**provisionally approved on 8/03/13**

The Railweight model Streamline TSR4000 weighing instrument, which is similar to the pattern, but uses two Streamline model STRMLNAU16 or STRMLNAU18 weighing transducer pairs rather than the Weighline transducers described for the pattern.

The instrument is approved for class 2 wagon weighing and class 2 train weighing, with a speed range of 0.1 to 3 km/h.

The Streamline weighing transducers utilise force transducer elements (four elements for each weighing transducer, each having a number of strain gauges bonded to them) which are bolted on to the rail (in accordance with the manufacturer's procedures) and hence result in the rail becoming a weighing transducer. A weighing transducer pair comprises a weighing transducer for each wheel of an axle. Different weighing transducer models (see Table 2 below) are formed according to the rail type.

TABLE 2

Rail type	48 kg, 50 kg, 60 kg, AS50, AS60, AS68, 56E1/113A, UIC54, UIC60, 115lb RE, 132lb RE	60 kg, 68 kg, 72 kg, AS60, AS68, UIC60, 136lb RE
Weighing transducer	Streamline STRMLNAU16	Streamline STRMLNAU18
Capacity of weighing transducer	16 t	18 t
Minimum capacity of weighing transducer	2.4 t	2.7 t

The weighing transducers are designed to form part of the continuous rail line in which the system is installed and are positioned between the rail supports (e.g. sleepers). Lengths of rail incorporating the weighing transducers may be welded or bolted (using 'fish plates') into the rail line.

Instrument specifications vary according to the capacity of the weighing transducer as shown in Table 3 below. In addition the instrument specifications are limited by the requirements of NMI R 106, Automatic Rail Weighbridges, dated July 2004 – in particular clauses 2.3 and 2.5, which restrict minimum and maximum wagon weights according to the value of scale interval (d) chosen. The value of scale interval (d) chosen shall be 50, 100, 200 or 500 kg.

TABLE 3

Maximum capacity of instrument (per axle)	2 × capacity of weighing transducer
Minimum capacity (per axle)	2 × minimum capacity of weighing transducer (from Table 2 above)
Maximum wagon weight	No. of axles × maximum capacity of instrument (or less). However the maximum wagon weight shall not exceed 600d.
Minimum wagon weight	No. of axles × minimum capacity (or more)

### 3. Description of Variant 4

**provisionally approved on 8/03/13**  
**approved 30/08/17**  
**amended 24/04/18**

The Railweight model Streamline TSR4000 weighing instrument, which is similar to variant 3, but using 5 or 6 Streamline model STRMLNAU16 (Figures 4 & 5) or STRMLNAU18 weighing transducer pairs, rather than the two pairs described in variant 3.

The instrument is approved for class 2 wagon weighing and class 2 train weighing with a speed range of 0.1 to 80 km/h.

### TEST PROCEDURE

Instruments should be tested in accordance with any relevant tests specified in the National Test Procedures.

The instrument shall not be adjusted to anything other than as close as practical to zero error, even when these values are within the maximum permissible errors.

#### **Maximum Permissible Errors**

The maximum permissible errors are specified in Schedule 1 of the *National Trade Measurement Regulations 2009*.



FIGURE 6/14H/5 – 1



(a) Railweight Model WEIGHLINE RWT-X TR60 Weighing Transducer



(b) Railweight Model Weighline TSR 4000 Weighing Processor

FIGURE 6/14H/5 – 2



Railweight Model WEIGHLINE RWT-X TR60 Transducer Installation  
(only 4 transducers visible)



FIGURE 6/14H/5 – 3

*t11			
Printed:	Date:	19/03/2009	Time: 03:08:13
System Id: 1318T			
Hexham			
ARTC			
New South Wales			
111			
Train arrival date: 19/03/2009			
Train arrival time: 03:05:12			
Direction : UP			
Serial No. : 5601			
Seq.	Weight (t )	Speed (km/h)	Status
1	* 170.2	NW*	8.1 6 Axle Veh.
2	* 170.2	NW*	9.8 6 Axle Veh.
3	102.8		10.5 4 Axle Wagon
4	101.4		11.1 4 Axle Wagon
5	INVALID	E	11.8 4 Axle Wagon AboveMax.
6	INVALID	E	12.4 4 Axle Wagon AboveMax.
7	INVALID	E	13.0 4 Axle Wagon AboveMax.
8	INVALID	E	13.4 4 Axle Wagon AboveMax.
9	105.2		13.7 4 Axle Wagon
10	104.4		13.9 4 Axle Wagon
11	103.2		14.1 4 Axle Wagon
12	101.4		14.2 4 Axle Wagon
13	103.0		14.3 4 Axle Wagon
14	101.4		14.3 4 Axle Wagon
15	91.8		14.4 4 Axle Wagon
16	91.2		14.3 4 Axle Wagon
17	80.6		14.3 4 Axle Wagon
18	80.8		14.3 4 Axle Wagon
19	80.4		14.3 4 Axle Wagon
20	81.2		14.2 4 Axle Wagon
21	69.8		14.1 4 Axle Wagon
22	71.6		14.0 4 Axle Wagon
23	60.8		13.9 4 Axle Wagon
24	60.6		13.7 4 Axle Wagon
25	61.2		13.6 4 Axle Wagon
26	61.8		13.4 4 Axle Wagon
27	50.8		13.3 4 Axle Wagon
28	51.4		13.2 4 Axle Wagon
29	INVALID	E	13.1 4 Axle Wagon BelowMin.
30	INVALID	E	12.9 4 Axle Wagon BelowMin.
31	INVALID	E	12.8 4 Axle Wagon BelowMin.
32	INVALID	E	12.8 4 Axle Wagon BelowMin.
33	INVALID	E	12.8 4 Axle Wagon BelowMin.
34	INVALID	E	12.7 4 Axle Wagon BelowMin.
35	69.2		12.7 4 Axle Wagon
TOTALS 1886.0 E !!! Not valid for trade purposes !!!			
Train max speed: 14.4 km/h Train departure date: 19/03/2009			
Train min speed: 6.3 km/h Train departure time: 03:07:37			

### Sample Ticket of Overweight and Underweight Train

\* Vehicles which are detected as being non-weighed vehicles (e.g. vehicles 1 and 2 above are locomotives) are marked on the ticket with the error message "NW\*" meaning 'not weighed'; their weights are not included in the total.

FIGURE 6/14H/5 – 4



Railweight Model STREAMLINE Model STRMLNAU16 Weighing Transducer

FIGURE 6/14H/5 – 5



Railweight Model STREAMLINE Model STRMLNAU16 Transducer Installation

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