DANAK
PROD Reg. nr 7026

FORCE Certification

EU Type Examination Certificate

No. 0200-MID-05861 Revision 1

Weighline TSR4000

AUTOMATIC RAIL-WEIGHBRIDGE

Issued by **FORCE Certification**
EU - Notified Body No. 0200

In accordance with the requirements in Directive 2014/32/EU of the European Parliament and Council.

Issued to **Avery Weigh-Tronix**
Foundry Lane
Smethwick
West Midlands B66 2LP
UNITED KINGDOM

In respect of An automatic rail-weighbridge designated **Weighline TSR4000** with variants of modules of load receptors, load cells and peripheral equipment.
Accuracy class: ≥ 0.5 (coupled wagon weighing)
≥ 0.2 (total train weighing).

The conformity with the essential requirements in Annex 1 and the specific requirements in Annex VIII (MI-006), chapter I & VI of the Directive 2014/32/EU is met by the application of OIML R106:1997, OIML D11:2013 and WELMEC Guide 7.2:2015.

Note. This certificate is a revised edition which replaces previous revisions.

The principal characteristics and approval conditions are set out in the descriptive annex to this certificate.

The annex comprises 12 pages.

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Valid until **2029-04-01**

Jens Hovgård Jensen
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FORCE Certification references:
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Descriptive annex

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1. Introduction

This pattern of an automatic rail-weighbridge, designated Weighline TSR4000, for the in-motion weighing of rail wagons, comprises the following:

- two, or more, pairs of Weighline transducers;
- wheel sensors;
- TSR4000 weight processor; and
- printer.

The instrument is designed for the weighing of axles and bogies of:

- coupled wagons in a train formation, pushed or pulled in both directions; and
- entire trains pushed or pulled in both directions.

2. Description of the construction and function

2.1 Weighline transducers

Two or more pairs of "Weighline" transducers are permanently bonded to each rail. Up to a maximum of 16 transducers (8 pairs) can be connected, via a transducer junction box, to each input channel of the TSR4000. Each Weighline transducer (OIML R60/1991-GB-94.08) has a maximum capacity of 15,000 kg. An MTL LC30 Surge Protector may be used with each transducer.

2.2 Wheel sensors

A number of pairs of wheel sensors are located on the track adjacent to the transducers to monitor the passage of wagons over the system. The wheel sensors can be either the mechanical contacting type or the non-contacting inductive proximity type.

2.3 TSR4000 weight processor

The TSR4000 weight processor (Figure 1) comprises the following:

- Processor card with a Pentium processor or equivalent
- Analogue to digital converter card
- Multifunction card
- PCI backplane
- Graphics type display module
- Inverter module for display illumination
- Power supply unit
- System motherboard
- Up to four pre-amplifier boards
- Keyboard interface board and front panel keypad
- External keyboard connector (optional)
- External VGA monitor connection (optional)

2.4 Printer

See section 4.2

2.5 Devices

The Weighline TSR4000 is provided with the following devices:

- Automatic detection of over-speed
- Automatic detection of roll-back
- Vehicle identification
- Semi-automatic and automatic zero-setting devices (≤ 4 % of Max.)
- Direction of travel detection
- Measurement of vehicle speed

2.6 Software

The software is designed to run exclusively on the TSR4000 weighing instrument and enables it to automatically weigh trains that pass across the instrument's sensors. The TSR4000 weighing instrument is based on an embedded microprocessor running proprietary software. The software, its parameters and weighing results are kept on a Flash memory device. The software operates under a multitasking real time kernel (RTK) with pre-emptive task switching for optimal response to external events. Critical events are changes in the wheel sensor's status and the transducer inputs' analogue to digital conversion buffer becoming half full. These critical events generate hardware interrupts which call service routines to collect the data and forward it for processing by the appropriate tasks. All tasks work in isolation with inter-task communication mediated by the RTKs messaging system.

The key data gathering tasks are the track logic task and the weight capture & processing task. The track logic task detects the start & end of trains, identifies vehicles, measures speed and processes any other digital inputs such as AEI tag read inputs. The weight capture & processing task analyses the transducer data. This operates either in a background mode where it can perform zero tracking, calibration or diagnostics or in a train-weighing mode where it identifies wheel weighing profiles and extracts a series of un-calibrated wheel weights for each transducer.

These tasks pass their output to a vehicle analysis task which matches the wheel weights to their vehicles, applies calibration and adjustments and stores the results in an internal database. At the end of the train this task notifies the reporter task that the train is complete. The reporter task then writes the results to the Flash memory. The reporter task is responsible for all the reporting functions of the instrument. There is a multitude of tasks dedicated to device management, including serial communications ports, parallel ports, printers, Flash memory and the user interface.

The software identification is "TSR4000 CIMW" and the approved software version number is

5.xxx-A or 5.xxx/yy

where xxx denotes updates & bug fixes that do not affect the metrological characteristics of the software, and yy denotes an optional alphanumerical suffix, that may be used by the manufacturer for installation identification purposes.

The version number can be found on the '**System Identification**' screen by navigating to **Main menu > Setup > System Information**.

The following is a complete list of commands that are available on the instrument.

- Enter “Ready To Weigh” state. (Instrument will weigh the next train.)
- Enter “Standby” state. (Instrument will not weigh in this state.)
- Set “Automatic” mode. (Stays in Ready To Weigh after weighing)
- Set “Semi-Automatic” mode. (Returns to Standby after weighing)
- Set “Manual” mode. (As for automatic, but trains are treated as a multipart train and concatenated until the standby command is issued.)

3. Technical data

3.1 Weighline TSR4000 specifications

The Weighline TSR4000 has the following technical characteristics:

Accuracy class	Coupled wagon weighing	≥ 0.5	≥ 1
	Total train weighing	≥ 0.2	
Maximum operating speed		≤ 10 km/h	10 to 25 km/h
Minimum operating speed		≥ 0.1 km/h	
Maximum wagon weight		≤ 120 000 kg	
Minimum wagon weight		≥ 6 000 kg	
Scale interval		≥ 20 kg	
Maximum capacity		≤ 33 000 kg (per axle)	
Minimum capacity		≥ 3 000 kg (per axle)	
Transducer type		Weighline, E_{max} ≤16 500 kg	
Max. no. of weighline transducers		16 (8 pairs)	
Max. number and type of wagons per train		Determined at verification	
Direction of weighing		Bi-directional (train pushed/pulled)	
Power supply		90-230 VAC, 50 Hz 115/230 VAC, 47-63 Hz (with Advantech PCI-6873 motherboard and an Enhance 200W Micro ATX power supply unit)	
Operating temperature range		-10 °C to +40 °C	
Climatic environment		Closed, non-condensing (TSR4000 weight processor)	
		Open, condensing (Weighline transducers)	
Electromagnetic classification		E2	

3.1.1 Weighline TSR4000 specifications for rail wagons containing liquids

The Weighline TSR4000 has the following technical characteristics when wagon(s) containing liquids:

Accuracy class	Total train weighing	Coupled wagon weighing
	≥ 1	
Maximum operating speed	Determined at initial verification	Determined at initial verification
Minimum operating speed	≥ 0.1 km/h	≥ 1 km/h
Maximum wagon weight	≤ 120 000 kg	≤ 100 000 kg
Minimum wagon weight	≥ 6 000 kg	
Scale interval	≥ 100 kg	
Maximum capacity	≤ 33 000 kg (per axle)	
Minimum capacity	≥ 3 000 kg (per axle)	
Transducer type	Weighline, E_{max} ≤16 500 kg	
Max. no. of weighline transducers	16 (8 pairs)	
Max. number and type of wagons per train	Determined at initial verification	
	Type: 2 and 4-axle	Type: 4-axle
Direction of weighing	Bi-directional (train pushed/pulled)	

3.2 TSR4000 specification

Excitation voltage: 17.5 VDC

Minimum input impedance (per channel): 93.75 ohm

Minimum input signal per scale interval: 17.5 µV

3.3 Load receptor and load cells

3.3.1 Weighline transducers

The Weighline transducers may only be installed in foundations that restrict any undue movement of the section of rail upon which the transducers are mounted.

3.3.2 Conventional Rail-Weighbridge Configuration

As an alternative to the use of Weighline transducers a conventional rail-weighbridge may be used. The weigh-rail length is 1.5 m or 1.6 m, although this may be extended to 3 m or 7.3 m to accommodate bogie and full draught weighing.

Foundation work is required to suit the unique conditions of each installation to ensure stability and correct alignment of the rails. The approach rails on each side of the weighbridge terminate in a mitred cut beneath which is a transverse beam or 2 longitudinal set on the weighbridge pit foundations, and supporting the ends of both approach rails. The weighbridge pit is of reinforced concrete with facilities for drainage and cable access. Anchor bolts are provided for the location of the steelwork, tie-rod fixings and load cell mountings.

Placement of the load cells in the pit is such that the vertical axis of each load cell lies beneath the end of the approach rail. In order to accommodate the load cells, the approach beams are profiled on their undersides. Each live rail, which is mitred to match the approach rail, is supported on a beam along its length. Two transverse members are welded between them so forming an integrated structure. The ends of the main beams are profiled so that they reach under the approach beams and rest on the load cells. Movement of the weighbridge in the horizontal plane is restrained by four tie-bars. Two of these act in the longitudinal direction and two in the transverse direction.

Any compatible analogue load cell(s) may be used provided the following conditions are met:

- There is a respective OIML Certificate of Conformity (R60) or a Part / Evaluation / Test Certificate (EN 45501) issued for the load cell by a Notified Body responsible for type examination under Directive 2014/31/EU.
- The certificate contains the load cell types and the necessary load cell data required for the manufacturer's declaration of compatibility of modules (WELMEC 2:2015), and any particular installation requirements). A load cell marked NH is allowed only if humidity testing to EN 45501 has been conducted on this load cell.
- The compatibility of load cells and indicator is established by the manufacturer by means of the compatibility of modules form, contained in the above WELMEC 2 document, or the like, at the time of EC verification or declaration of EC conformity of type.
- The load transmission must conform to one of the examples shown in the WELMEC 2.4 Guide for load cells.

3.4 Documents

The documents filed at FORCE (reference No. 119-23235.90.30) are valid for the weighing instruments described here.

4. Interfaces and peripheral equipment

4.1 Interfaces

The instrument may have the following interface types:

- 2 serial RS232 / RS422 ports
- One parallel port (optional)
- Transducer and wheel sensor inputs

4.2 Peripheral devices

The instrument may be connected to any peripheral device that has been issued with a Part Certificate or Evaluation Certificate issued by a Notified Body responsible for Module B under Directive 2014/32/EU and bears the CE marking of conformity to the relevant directives; or

A peripheral device without a Part or Evaluation certificate may be connected under the following conditions:

- it bears the CE marking for conformity to the EMC Directive;
- it is not capable of transmitting any data or instruction into the weighing instrument, other than to release a printout, checking for correct data transmission or validation;

- it prints weighing results and other data as received from the weighing instrument without any modification or further processing; and
- it complies with the applicable requirements of Paragraph 8.1 of Annex I.

When the instrument detects that a wagon weighing was over the maximum permitted weighing speed or a wheel weight of that wagon exceeded the transducer capacity or the wagon weight was outside the permitted weighing range, then the weight on the printout will be replaced with asterisks '********' and 'OverSpeed', 'OverCapacity', 'AboveMaximum' or 'BelowMinimum' will be printed next to that wagon, as appropriate. The displayed weight of that wagon on the instrument front panel will be shown as dashes '------- ', and the display title 'Vehicle Weight' will be changed to 'OverSpeed', 'OverCapacity', 'AboveMaximum' or 'BelowMinimum', as appropriate.

5. Approval conditions

5.1 Remote operation

The TSR4000 instrument may be remotely operated via a permanently installed standard PC. The PC is connected to the instrument using the serial connection and runs a Railweight program allowing the following operations using mouse-operated buttons: Start Weigh, Abort Weigh and End Weigh. The TSR4000 should not allow any other commands once the instrument has been sealed according to section 7.

5.2 Compatibility of modules

The instrument shall fulfil composition of modules according to EN 45501:2015 annex F, if a conventional rail- weighbridge is used.

6. Special conditions for verification

6.1 TSR4000 variants

The TSR4000 may be found in the following variation,

- Having the instrument fitted with an alternative Advantech PCI-6873 motherboard and an Enhance 200W Micro ATX power supply unit.
- Having the instrument fitted with an alternative processor board (Single Board Computer) type SBC-5539-VL2, manufactured by Modular Industrial Systems Inc. and a power supply unit type SFX-0525H manufactured by Enhance Electronics UK.
- Having the instrument fitted with an alternative processor board (Single Board Computer) type VDX3-PCI, manufactured by ICOP Technology, Taiwan.
- Having an alternative build of the TSR4000 wherein the instrument has an LCD display, type PG 320240-D, manufactured by PowerTip; and mains power supply unit type SS-350SFE, manufactured by Seasonic.
- Using a modified pre-amplifier circuit, drawing A3-06-2643 revision 3.

6.2 Twin track mode

The controller functions as a single weighing instrument which dynamically selects a sub-set of active transducers. Wheel sensors are present on both tracks and are used for vehicle identification (as normal) and also to select which sub-set of transducers will be processed to provide the weights. The dynamic biasing has entries for both tracks and is set independently for each track.

When the instrument is “Ready To Weigh” it will monitor both tracks for an incoming train. When it detects a train it will lock out the other track for the duration of the train weighing. All weights from the “other track” will be discarded.

Identification of the track being used for weighing is given on the TSR4000 display and weigh-bills (see Figures 4 and 5 for examples).

Both lines must have the same metrological characteristics, and the rating plate shall bear the wording “Dual track” with the track’s designation as shown on the display and weigh bills.

The software version number remains as described in section 2.6. The dual track configuration is set up when the system is configured. An example track name configuration screen is shown in Figure 6.

7. Securing and location of seals and verification marks

7.1 Securing and sealing

Seals shall bear the verification mark of a notified body or alternative mark of the manufacturer or his representative according to ANNEX II, module F or D of Directive 2014/32/EU.

The inscription plate is located visible on the indicating device and is secured, either by sealing or by being of a form such that it is destroyed when removed.

Access to the calibration and configuration parameters is protected by a slide switch mounted on the top edge of the Multifunction Card. The switch is secured by the application of a tamper-evident sticker.

Components that may not be dismantled or adjusted by the user (jumper on main board when applicable, electronics, load cell connection) must be secured. Wire and seal solution or a tamper-evident sticker (bearing a securing mark) or common serial numbers may be used.

8. Location of CE mark of conformity and inscriptions

8.1 Scale

8.1.1 CE mark

CE mark and supplementary metrological marking shall be applied to the instrument according to article 20 of Directive 2014/32/EU.

8.1.2 Inscriptions

Shown on the information screens of TSR4000 display (see figure 2 & 3)
(Press F1 to enter information screens.)

- Accuracy class train mass
- Accuracy class wagon mass
- Maximum capacity
- Minimum capacity
- Scale interval, d =
- Scale interval, d_s =
- Maximum operating speed, v_{max} =
- Minimum operating speed, v_{min} =
- Maximum transit speed
- Maximum number of wagons per train
- Minimum number of wagons per train
- Number of partial weighings per wagon (if applicable)
- Maximum wagon mass
- Minimum wagon mass
- Direction of weighing
- Wagons pushed/pulled
- Can be used to weigh wagons containing liquids
- Supply voltage

On the inscription plate of the instrument:

- Manufacturer's name and/or trademark
- Postal address of manufacturer
- Type designation
- Serial number
- Dual track info (if applicable)
- Temperature range: -10 / +40 °C (optional)
- Electromagnetic class: E2
- Humidity
- EU type examination certificate number

The markings and inscriptions shall fulfil the requirements of Article 8, Article 21, Article 22 and Point 9 of Annex I of Directive 2014/32/EU.

9. Pictures

Figure 1 TSR4000 controller

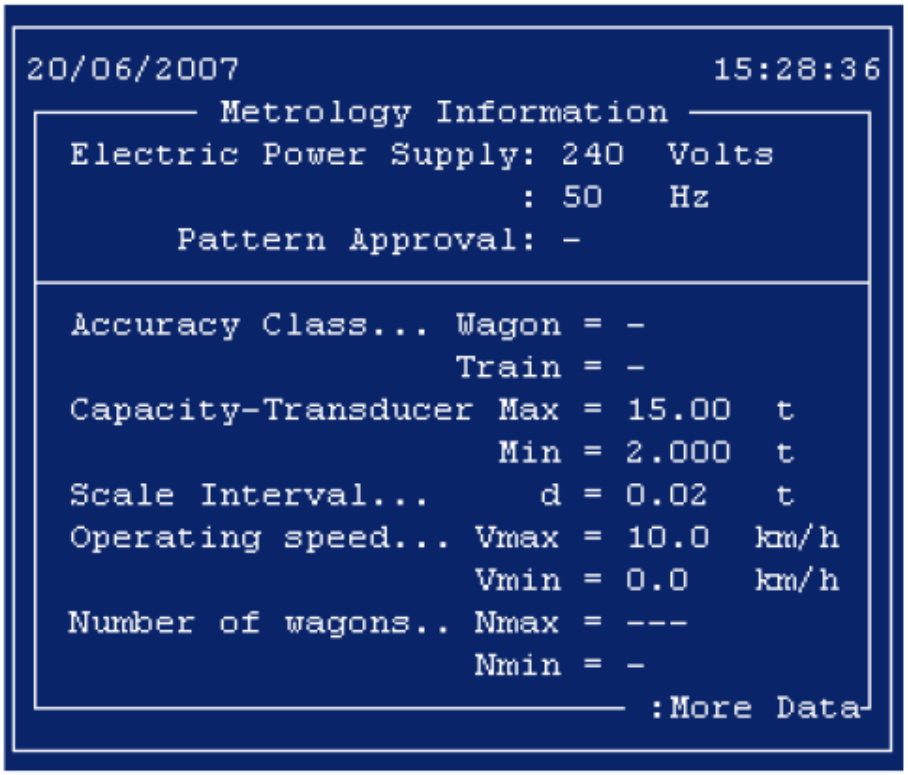

Figure 2 Information screen 1

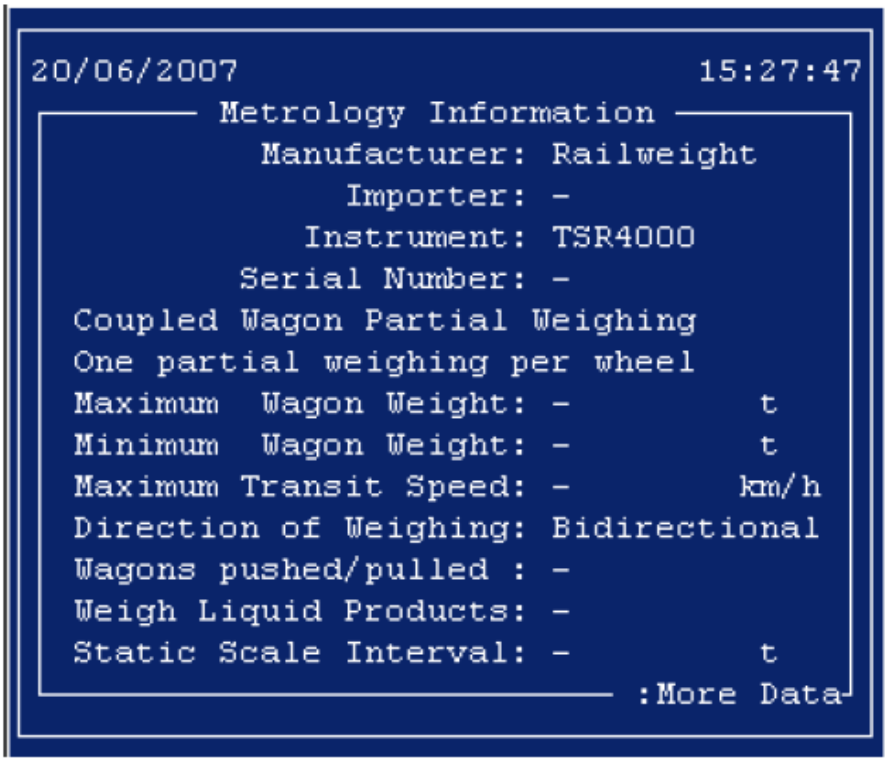

Figure 3 Information screen 2

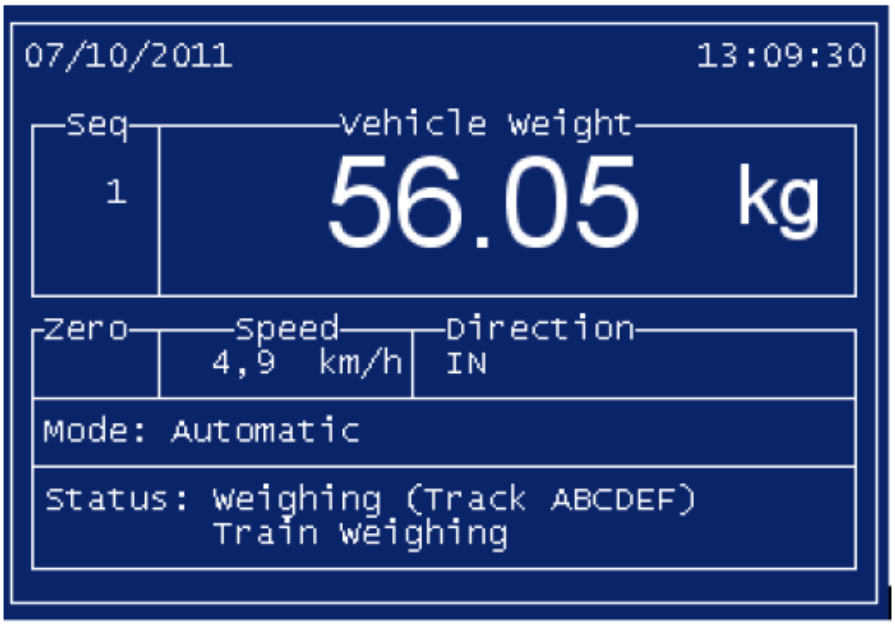

Figure 4 Example dual-track configuration shown on display

```
Printed:      Date:  07/10/2011  Time:  13:39:36

System Id: 1343T

Site Name
More site name
Even more site name

Train arrival date: 07/10/2011
Train arrival time: 13:09:17
Direction         : IN
Serial No.        : 14495
Track             : Track ABCDEF

Seq.          Weight    Speed Status
  1            56.05      4.9
  2            56.05      4.9
  3            56.05      4.9
  4            56.05      4.0
  5            56.05      4.9
  6            56.05      4.9
    TOTALS    336.30  t

Train max speed:   4.9 km/h     Train departure date: 07/10/2011
Train min speed:   4.0 km/h     Train departure time: 13:10:32
```

Figure 5 Example dual-track configuration shown on weigh bill

Figure 6 Example dual-track name configuration screen