Australian Government
National Measurement Institute

Bradfield Road, West Lindfield NSW 2070

Cancellation

Certificate of Approval
No 6/10B/74

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

This is to certify that the approval for use for trade granted in respect of the

Pfister Model SOLAR Train Weighing-in-motion Instrument

submitted by Pfister Waagen Bilanciai GmbH
Stätzlinger Strasse 70
D-86165 Augsburg
GERMANY

has been cancelled in respect of new instruments as from 1 November 2010.

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

Australian Government

National Measurement Institute

12 Lyonpark Road, North Ryde NSW 2113

Certificate of Approval

No 6/10B/74

Issued by the Chief Metrologist under Regulation 60
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Pfister Model SOLAR Train Weighing-in-motion Instrument

submitted by Pfister Waagen Bilanciai GmbH
Stätzlinger Strasse 70
D-86165 Augsburg
GERMANY.

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.

CONDITIONS OF APPROVAL

This approval becomes subject to review on 1 January 2010, and then every 5 years thereafter.

Instruments purporting to comply with this approval shall be marked with approval number ‘NSC 6/10B/74’ and only by persons authorised by the submittor.

Instruments purporting to comply with this approval and currently marked ‘NSC P6/10B/74’ may be re-marked ‘NSC 6/10B/74’ but only by persons authorised by the submittor.

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It is the submittor'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.

The National Measurement Institute reserves the right to examine any instrument or component of an instrument purporting to comply with this approval.

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

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 Standards Commission is unable to clearly define particular requirements for material on which the rail sleepers shall rest.

It is the responsibility of the submittor 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.

DESCRIPTIVE ADVICE

Pattern: provisionally approved 27 August 2003
approved 16 December 2004

- A Pfister model SOLAR train weighing-in-motion instrument.

Technical Schedule No 6/10B/74 describes the pattern.

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FILING ADVICE

The documentation for this approval comprises:

Certificate of Approval No 6/10B/74 dated 17 December 2004
Technical Schedule No 6/10B/74 dated 17 December 2004 (incl. Test Procedure)
Figures 1 to 5 dated 17 December 2004

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

TECHNICAL SCHEDULE No 6/10B/74

Pattern: Pfister Model SOLAR Train Weighing-in-motion Instrument

Submittor: Pfister Waagen Bilanciai GmbH
Stätzlinger Strasse 70
D-86165 Augsburg
GERMANY

1. Description of Pattern

A Pfister model SOLAR weighing instrument for the determination (by measurement of wheel forces) of the mass of each wagon and the total mass of a train, when weighed in motion.

The Pfister model SOLAR weighing instrument comprises a load receptor incorporating a number of special sleeper modules incorporating load cells, on which the rail rests, together with a number of lateral force sensors, which are inserted into the rail by drilling as part of the system installation.

The sleeper modules and lateral force sensors are connected to a Pfister model SOLAR on-site cabinet, which incorporates A/D converter modules which in turn supply measurement data to a personal computer (PC) for processing and determination of wagon and total train mass.

The instrument is approved for class 1 (or 2) wagon weighing and class 0.5 (or 1 or 2) train weighing. The system uses Pfister model SOLAR weighing transducers and can measure a maximum wagon weight of up to 120 t, a minimum wagon weight of 15 t, with a scale interval of no greater than 200 kg, over a speed range of 5 to 80 km/h.

Note: Limited speed ranges may apply for different classes and types of weighing, e.g. 5 to 15 km/h for class 1 wagon weighing.

Information from the sleeper modules and lateral force sensors is also used for wagon/ locomotive identification purposes, to provide information regarding train speed, [and to determine train roll-back] and track switches are not required.

Notes: Additional lateral force sensors may be used to provide additional wheel location (“track switch”) information where necessary.

The system may also incorporate wagon identification (e.g. RFID tag) readers.

The system may be provided with facilities (e.g. indicator lights) to advise the train driver of conditions such as underspeed, overspeed or other errors. Where such facilities are not provided the rail operator may need to make other provisions for possible re-weighing or alternative charging arrangements.

The weighing system may be powered by an uninterruptible power supply.

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1.1 Load Receptor

The load receptor comprises 7 special Pfister model SOLAR sleeper modules incorporating load cells, on which the rail rests, together with a number of lateral force sensors. Hence the length of the load receptor is approximately 4.2 m.

Each sleeper module (Figures 1 and 2) incorporates two Gassmann Theiss Messtechnik model LWL-DMS load cell modules of 10 t maximum capacity (Figure 3a). The load cell modules are located directly below the rails, and the rails are interconnected by means of an I-beam.

Four Gassmann Theiss Messtechnik model S QKS lateral force sensors (Figure 3b) are used, one located in each rail at both ends of the load receptor.

1.2 SOLAR On-site Cabinet

The Pfister model SOLAR on-site cabinet (Figure 4) houses nine Gassmann Theiss Messtechnik model LWL-DMS A/D converter modules (one for each sleeper module or pair of lateral force sensors – Figure 6). These converter modules provide the excitation to the load cells and the lateral force sensors, and amplify and digitise the signal from these transducers.

The measuring data output of the LWL-DMS A/D converter modules is provided in a digital form via fibre optic cable.

This measuring data is provided to an industrial PC (also located within the on-site cabinet), which is fitted with a fibre optic interface card, and a Gassmann Theiss Messtechnik model UNICOM-TS card for sealing purposes (marked LP042-3 for identification – see Figure 5 and clause **1.9 Sealing**).

This industrial PC uses Pfister SWSSOFT version V01.01 (#) software to perform the following functions during the weighing operation:

- Store the acquired weight data from the weighing transducers;
- Transmit speed information to the MVO software (see below) during the weighing operation;
- Perform data analysis of the stored weight information from the weighing transducers (applying filtering algorithms and correction factors – see clause **1.5 Calibration Process and Calibration Factors**) after completion of the train weighing;
- Form a set of data including the wagon weights which may be used for trade, and also including axle and bogie weights, distances and speed; and
- Output this set of data to the MVO software (see over) running on an external personal computer.

(#) Later versions of the SWSSOFT (V01.xx) software may be used provided that any updates do not affect any aspect related to the approval of the instrument.

The on-site cabinet also contains a power supply unit (nominally 24V and 5A).

The on-site cabinet shall be located in an airconditioned enclosure, room or building. The degree of airconditioning may be dependent on the location of the installation (it is expected that cooling facilities would be necessary for all locations within Australia, however heating may not be necessary in hot & temperate climates), and shall be at the discretion of the appropriate trade measurement authority. The authority may require that provision be made to ensure that satisfactory operation of the airconditioning is maintained (e.g. by an alarm system in the case of an installation which is normally unattended).

1.3 System Interface/Operation Personal Computer

The instrument uses a personal computer (separate to that within the SOLAR on-site cabinet) running MVO software for the operation of the system and display of results. This personal computer may be connected to the SOLAR on-site cabinet using various computer communication methods and protocols (e.g. fibre optic link, RS-232, networking protocols including wireless modems or wireless networks).

1.4 Indication – MVO Software

The MVO software provides the operator interface of the instrument. In addition the software performs the following functions during the weighing process:

- Uses speed information provided by the SWSSOFT software running in the SOLAR on-site cabinet during the weighing process to provide speed indications such as warning of over-speed;
- Receives the set of data representing the wagon, bogie and axle weights and distances and speed from the SWSSOFT software running in the SOLAR on-site cabinet; and
- Provides reports.

The MVO software has facilities for management of train information in addition to the weighing operation. The system utilises a database system (e.g. Microsoft Access or Interbase) to maintain these records. The primary indication of the instrument is considered to be the weighing printout (accessed by selecting the *Print Weighing Report* button on the form accessed through the *Reports Weighing Report* menu).

A printer and/or a modem for the output of measurement reports is connected to the PC running the MVO software. The measurement reports may in addition be provided to another computer system via a computer network.

Note: A personal computer running the MVO software shall be available locally at the time of verification/certification for viewing weighbridge operations.

1.5 Calibration Process and Calibration Factors

Filtering algorithms and correction factors are applied to weight data sampled from the weighing transducers. Parameters involved in this process are stored in a calibration configuration data file stored within the PC running SWSSOFT software within the SOLAR on-site cabinet.

In the calibration of an installation the calibration configuration data file is produced in a process involving the following:

- A standard 'factory' configuration data file is written into the SOLAR on-site cabinet, for use by the SWSSOFT software;
- The test train is run over the weighbridge (a number of times) in the directions and speed ranges required;
- In a separate Pfister application (e.g. a Microsoft Excel spreadsheet), the reference wagon weights and the wagon weights obtained by the SOLAR system are compared and the correction factors for this installation are calculated.
- These factors are written in the configuration data file and stored; and
- Sealing is carried out in accordance with clause **1.9 Sealing**, so that any unauthorised alteration of the calibration configuration data file can be detected.

The instrument has an automatic zero setting device to ensure that the instrument is maintained at zero prior to weighing beginning.

1.6 Printout

The wagon identification, sequence number, speed, individual wagon mass and total train mass are printed, as are any overspeed or other error messages (a legend including the meanings of any error codes shall be included).

Other information may also be printed but locomotive masses will not be printed. Where an error has occurred in the weighing, a total train weight may be printed, but shall exclude any incorrectly weighed wagons and shall be printed with a message such as "TOTAL (Excluding incorrectly weighed wagons)".

1.7 Roll-back Detection

In the case of roll back the weighing is aborted and a message is seen on the screen "Roll Back". The weighing must be started again.

1.8 Specifications

Accuracy class:	train weighing	0.5, 1 or 2	(#1)
	wagon weighing	1 or 2	(#1)
Maximum capacity		30 t per axle	
Minimum capacity		2.5 t per axle	
Scale interval		50 kg	
Maximum wagon weight		120 t	
Minimum wagon weight		10 t	
Maximum operating speed		85 km/h	(#2)
Minimum operating speed		5 km/h	(#2)

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:

- Amending allowable accuracy classes (#1);
- Limiting the maximum or minimum wagon weights;
- Limiting the allowable speed range(s) (#2) for different classes and types of weighing, e.g. 5 to 15 km/h for class 1 wagon weighing; or
- 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 below:

Accuracy class train weighing	0.5, 1 or 2
Accuracy class wagon weighing	1 or 2
Maximum capacity	30 t per axle
Minimum capacity	2.5 t per axle
Scale interval	50 kg
Maximum wagon weight	No. of axles x 30 t (or less)
Minimum wagon weight	No. of axles x 2.5 t (or more)
Maximum operating speed	85 km/h or less
Minimum operating speed	5 km/h or more

1.9 Sealing Provision

Calibration parameters are stored in a parameter file, secured with a cyclic redundancy check (CRC) to minimise the possibility of unauthorised alteration. In addition, each 'write access' to the parameter file increases the count of an incremental access counter, the value of which is written to an EPROM on a special circuit board ('card' – Gassmann Theiss Messtechnik model UNICOM-TS – for identification purposes, this card (Figure 5b) is marked with the identification LP042-3) that is within the industrial PC inside the SOLAR on-site cabinet (i.e. that running the SWSSOFT software).

This card has a switch (Figure 5b) which can prevent write access to the EPROM and hence sealing this switch (by means of a destructible adhesive label) can seal the calibration access counter.

The value of the calibration access counter at the time of verification/certification may be recorded, and/or written on the destructible adhesive label, so that any alteration of parameters can be detected.

The value of the access counter in operation during operation of the instrument is recorded with each wagon weight value. These values may be seen by selecting the button 'View Verifiable Data', from the 'System' menu.

In addition to the above, the LWL-DMS A/D converter modules may be sealed to prevent removal of these modules (Figure 5a).

1.10 Verification/Certification Provision

Provision is made for the application of a verification/certification mark.

1.11 Descriptive Markings

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	Pfister Waagen Bilanciai GmbH
Importer's name or mark	Colonial Weighing Australia
Model designation	SOLAR
Serial number of the instrument	…..
Pattern approval mark	NSC 6/10B/74
Accuracy class	
Train weighing	0.5
Wagon weighing	2
Maximum capacity	Max (axle) 30 t
Minimum capacity	Min (axle) 2.5 t
Scale interval	d = 50 kg
Maximum wagon weight	No. of axles x 30 t
Minimum wagon weight	No. of axles x 2.5 t
Maximum operating speed	v max = 85 km/h
Minimum operating speed	v min = 10 km/h
Maximum number of wagons per train (If less than 60 wagons)	n max …..

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 **1.8 Specifications**) 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 Measurement Institute should be consulted for guidelines regarding this.

Note 1: 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.

Note 2: Where an installation is only to be used with wagons of a particular configuration (e.g. all with 8 wheels) the maximum and minimum wagon weight values maybe expressed as a value rather than the formula shown in the example.

Note 3: Where an instrument has been verified/certified only for a certain mode of operation (e.g. pulling of wagons in one direction), this shall be included in the instrument markings.

TEST PROCEDURE

Instruments shall be tested in accordance with Test Procedure No 20, *Weighing-in-motion Weighing Instruments*, but with the maximum permissible errors for weighing-in-motion and the dynamic test procedure modified as follows:

1. Maximum Permissible Errors

The maximum permissible errors for weighing-in-motion shall be:

(i) Wagon Weighing (Accuracy class 1 or 2)

The maximum permissible error for dynamic weighing of a coupled wagon during initial verification/certification:

(a) ±N% of the wagon weight, rounded to the nearest scale interval;

(b) ±N%, rounded to the nearest scale interval, of the weight of a single wagon equal to 35% of the maximum wagon weight as inscribed on the descriptive markings; or

(c) ± one scale interval,

whichever is the greatest, where

N = 0.50 for accuracy class 1; and

N = 1.00 for accuracy class 2.

Errors of not more than 10% of the weighing results, taken from one or more passes of the test train, may exceed the maximum permissible error but shall not exceed two times that value.

(ii) Train Weighing (Accuracy class 0.5, 1 or 2)

The maximum permissible error for dynamic weighing of a train of coupled wagons during initial verification/certification shall be:

(a) ±T% of the total train weight, rounded to the nearest scale interval;

(b) ±T%, of the weight of a single wagon equal to 35% of the maximum wagon weight as inscribed on the descriptive markings, times the number of wagons in the train but not exceeding 10 wagons, rounded to the nearest scale interval; or

(c) ± one scale interval for each wagon in the train, but not exceeding 10 scale intervals,

whichever is the greatest, where

T = 0.25 for accuracy class 0.5;

T = 0.50 for accuracy class 1; and

T = 1.00 for accuracy class 2.

In-service Errors

The maximum permissible errors applicable in-service are twice the values for initial verification/certification.

2. Dynamic Test Procedure

The dynamic test procedure and the number of test wagons in the test train are detailed below.

(i) Test Train

The types and number of wagons shall be in accordance with the normal operation of the instrument provided that the number does not exceed 60.

The test train shall be made up of test wagons and normal operational wagons. The wagons shall be loaded to represent the loads weighed by the weighing instrument. If the loads vary, then wagons full, partially filled, and empty shall be used as applicable.

(ii) Number of Test Wagons

Each test train shall have not less than five and not normally more than 15 test wagons in accordance with the table below.

If the number of test wagons is less than the total number of wagons in a test train, the test wagons shall be distributed evenly throughout the train.

3. Performance Requirements

The test train shall be weighed repeatedly to yield not less than 60 wagon weights or their equivalent in total train weight. Every weight indication and printout shall comply with the maximum permissible errors.

If applicable, repeat the tests for other speeds, other directions of travel, or other entry or exit tracks to or from the weighing instrument.

Total number of wagons in test train (n)	Minimum number of test wagons
$n < 10$	n
$10 < n < 30$	10
$30 < n$	15

4. Other Tests

Carry out tests to check the correct operation of the instrument (including printed record) for:

- over or under speed;
- over weight;
- roll-back; and
- calculations (net weight, totals).

6/10B/74
15 September 2005

Australian Government

National Measurement Institute

12 Lyonpark Road, North Ryde NSW 2113

Notification of Change
Certificate of Approval No 6/10B/74
Change No 1

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

The following change is made to the approval documentation for the

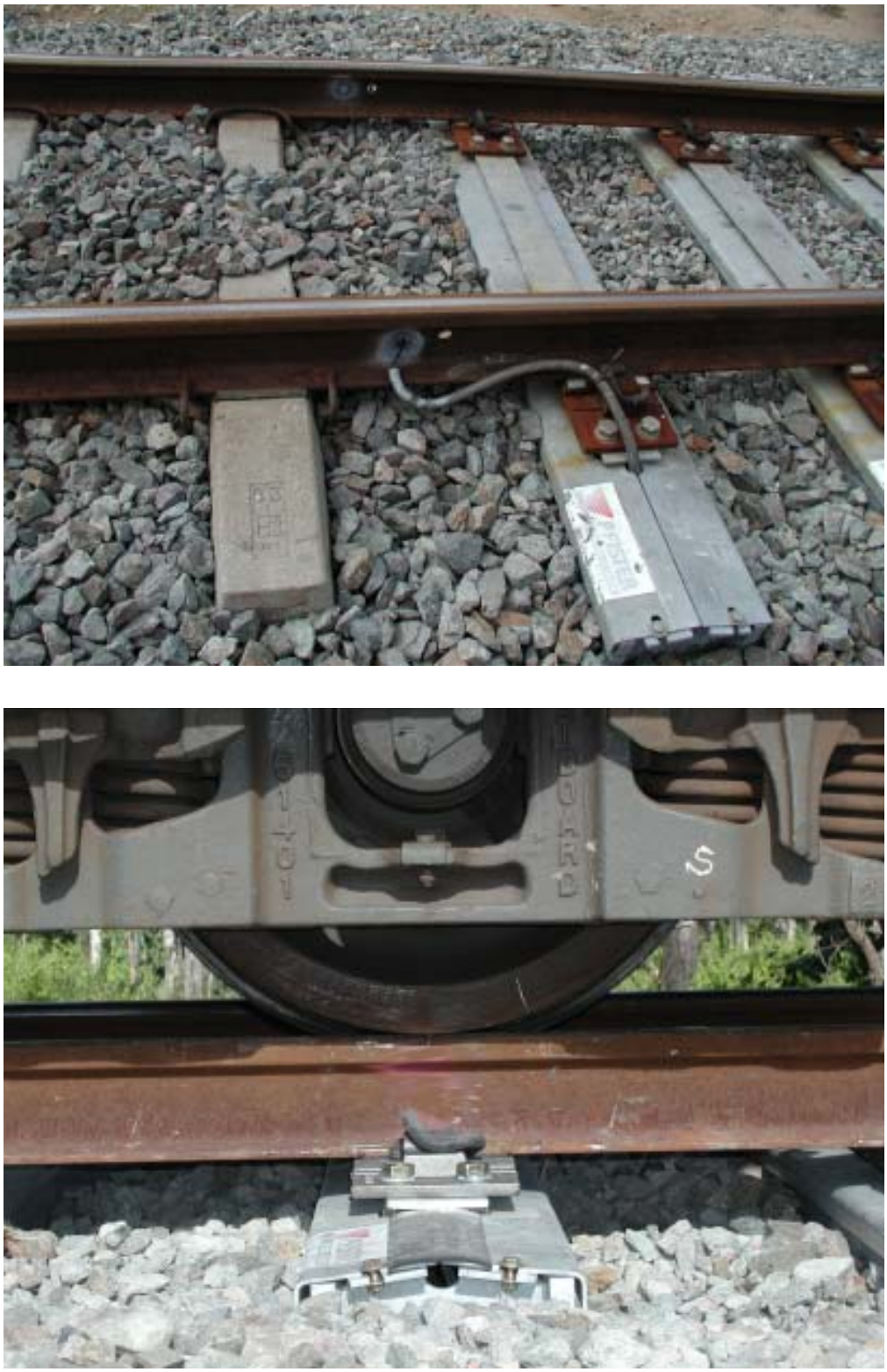
Pfister Model SOLAR Train Weighing-in-motion Instrument

submitted by Pfister Waagen Bilanciai GmbH
Stätzlinger Strasse 70
D-86165 Augsburg
GERMANY.

In Technical Schedule No 6/10B/74 dated 17 December 2004 clause **1. Description of Pattern**, the maximum speed given in the 4th paragraph should be amended to read '**85** km/h' (to be consistent with the maximum speed listed elsewhere).

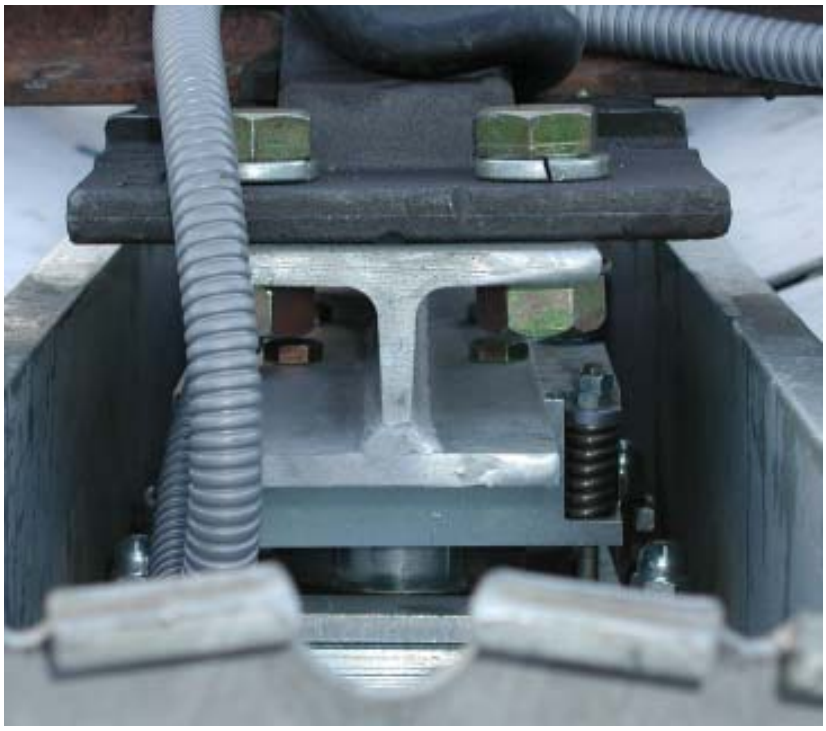
Signed by a person authorised by the Chief Metrologist to exercise his powers under Regulation 60 of the National Measurement Regulations 1999.

FIGURE 6/10B/74 – 1

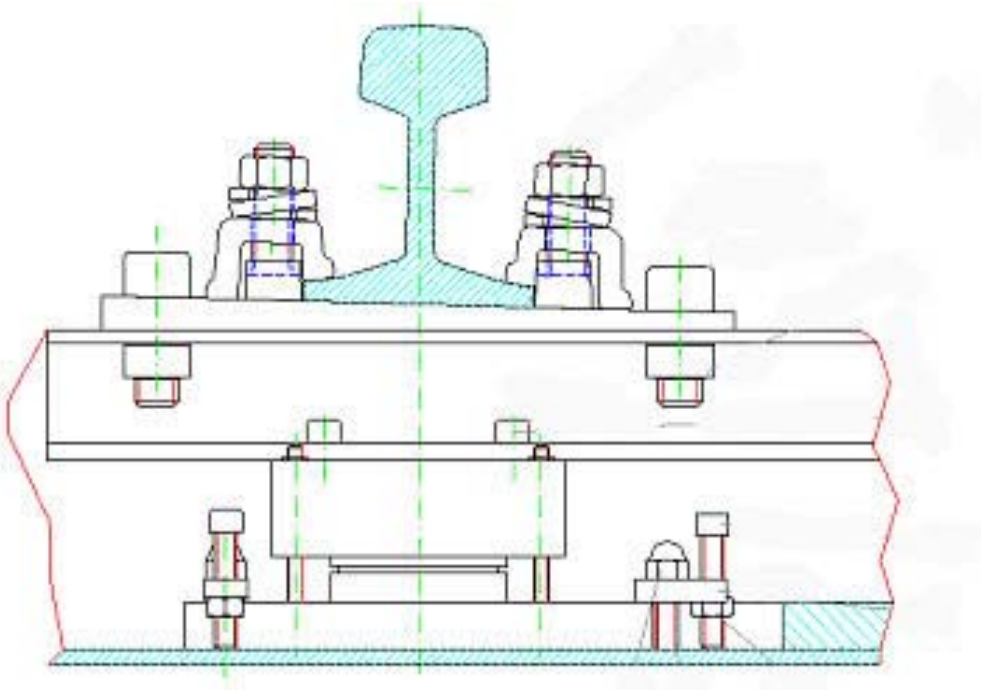


Pfister Model SOLAR Sleeper Module

FIGURE 6/10B/74 – 2

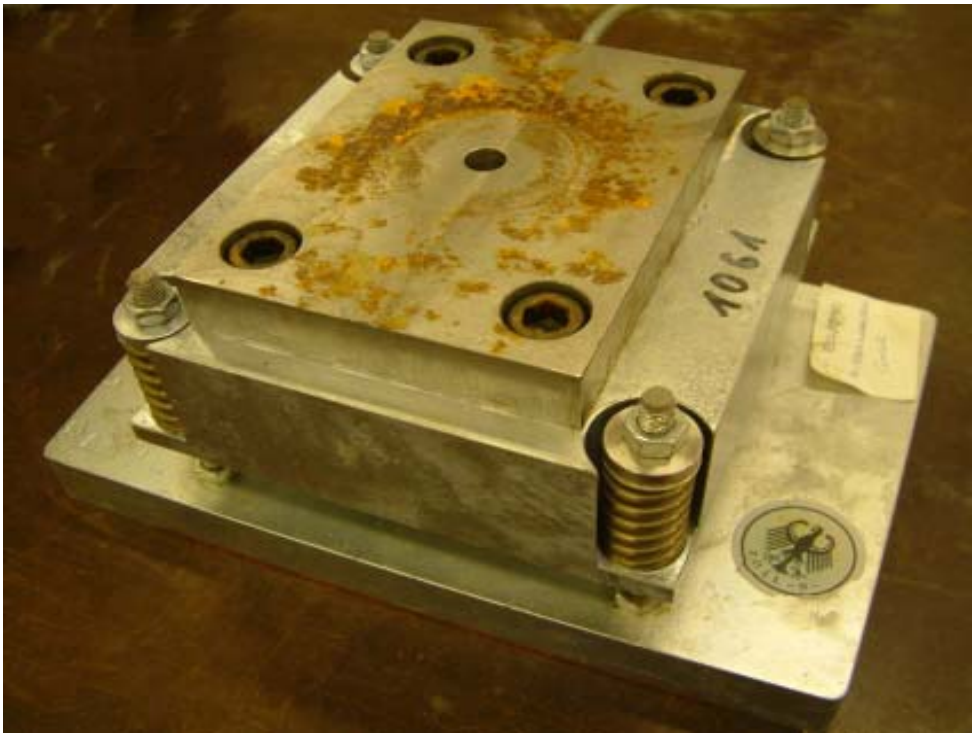


Pfister Model SOLAR Sleeper Module – Showing Load cell Module, I-beam and Rail Mounting Hardware



Pfister Model SOLAR Sleeper Module – Cross-section Perpendicular To Rail

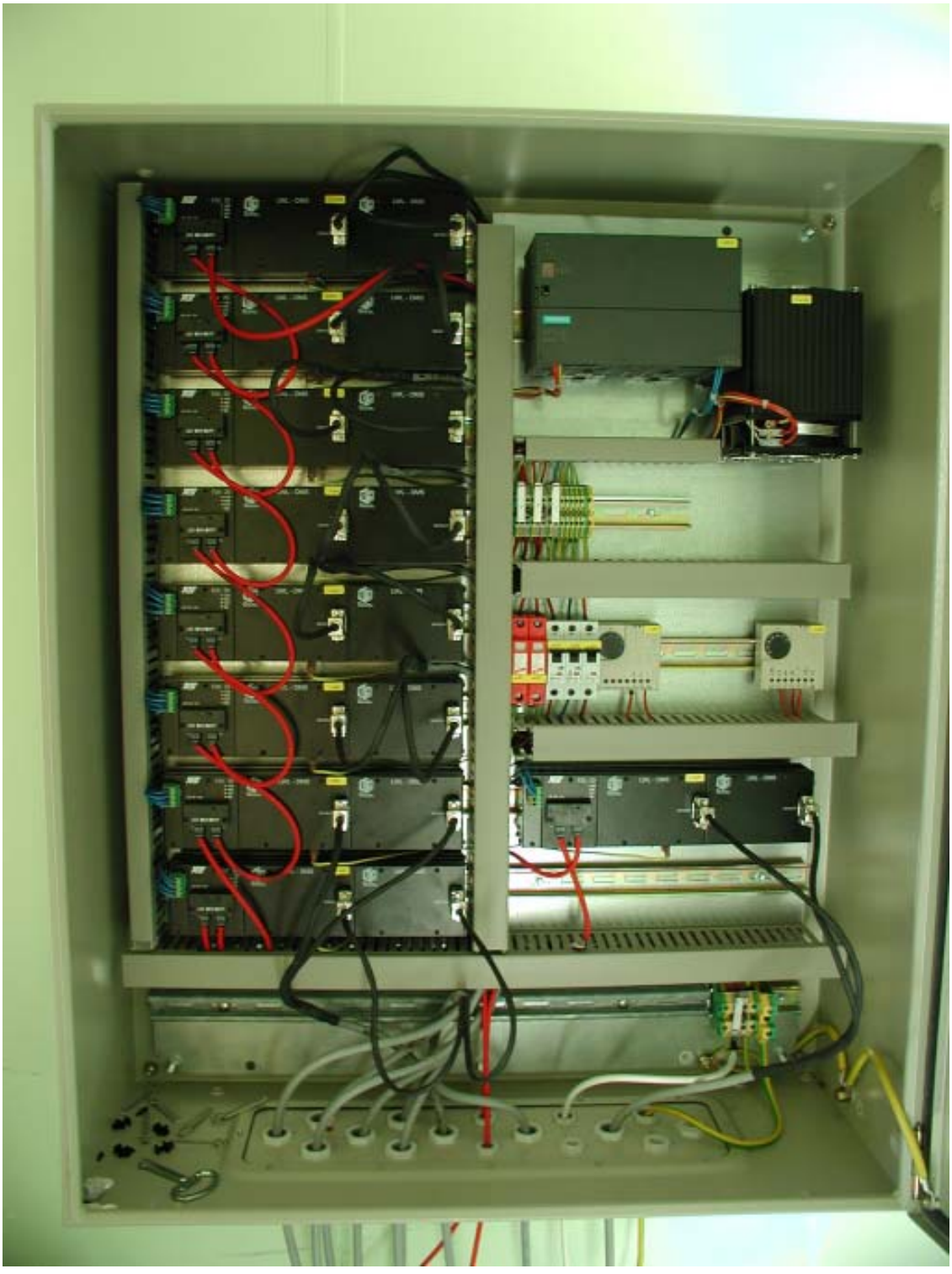
FIGURE 6/10B/74 – 3



(a) Gassmann Theiss Messtechnik Model LWL-DMS Load Cell Module

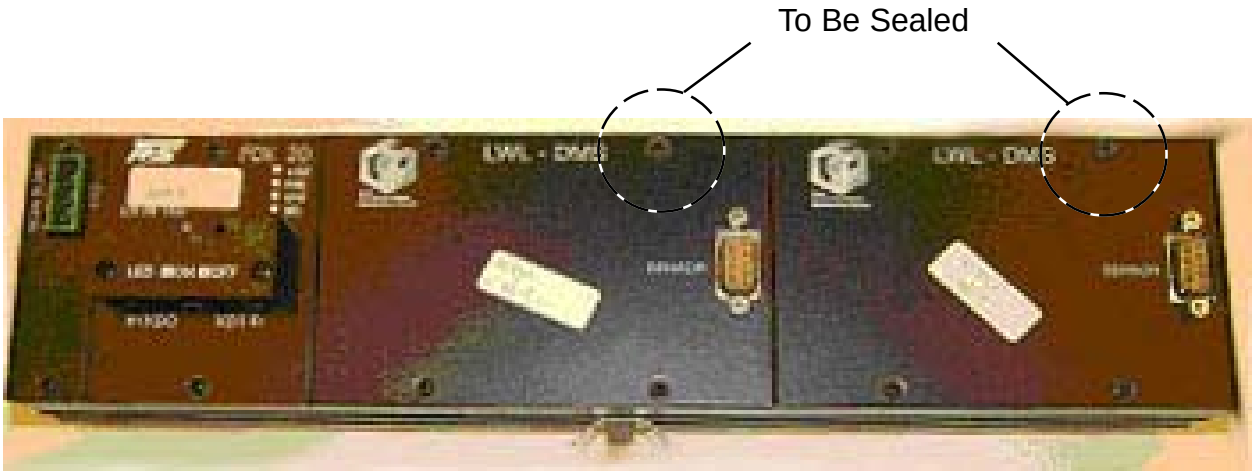
(b) Gassmann Theiss Messtechnik Model S QKS Lateral Force Sensor

FIGURE 6/10B/74 – 4



Pfister Model SOLAR On-site Cabinet

FIGURE 6/10B/74 – 5



(a) Gassmann Theiss Messtechnik Model LWL-DMS A/D Converter Module

(b) Gassmann Theiss Messtechnik Model UNICOM-TS Card