ScrapMan
Trailer Weighing System Manual

Contents

Appendices

This manual should be read in association with a number of technical bulletins that can be found in the appendices; this is particularly relevant to Calibration.

Important Technical Bulletins

Appendix 1 *Principles of Mobile Weighing*
Appendix 2 *Software Integration*
Appendix 3 *Calibration Notes*

The *Calibration Notes* document gives background information on load cell operation and calibration techniques and must be understood BEFORE any attempt at calibration.

Overview

The ScrapMan weighing system incorporates a number of sophisticated elements that in combination produce an accurate and reliable mobile weighing system.

Load cells are used to support the weighing platform; there is one under each corner of the weighing platform and *digital* load data is transmitted from individual load cells to the central computer in the trailer swan neck.

Embedded Computer Assembly resides in the computer enclosure in the LH-side of the trailer swan neck. This embedded PC runs under a Windows CE operating system and the application program resides in a CompactFlash memory. The CPU processes the data from the load cells and orchestrates communication to external computer equipment via WiFi (or optional RS232); it also provides a focal point for all the wiring and power supplies.

Wireless LAN WiFi technology is used on site to communicate weight from the Trailers AND provide access to the Utilities Menu in the trailer.

Batteries are used to energise the equipment using two 12V, 110Ah deep-cycle batteries which are housed in the RH -side of the trailer swan neck. The battery compartment also includes an ***intelligent*** battery charger and requires only a connection to a mains supply to commence charging.

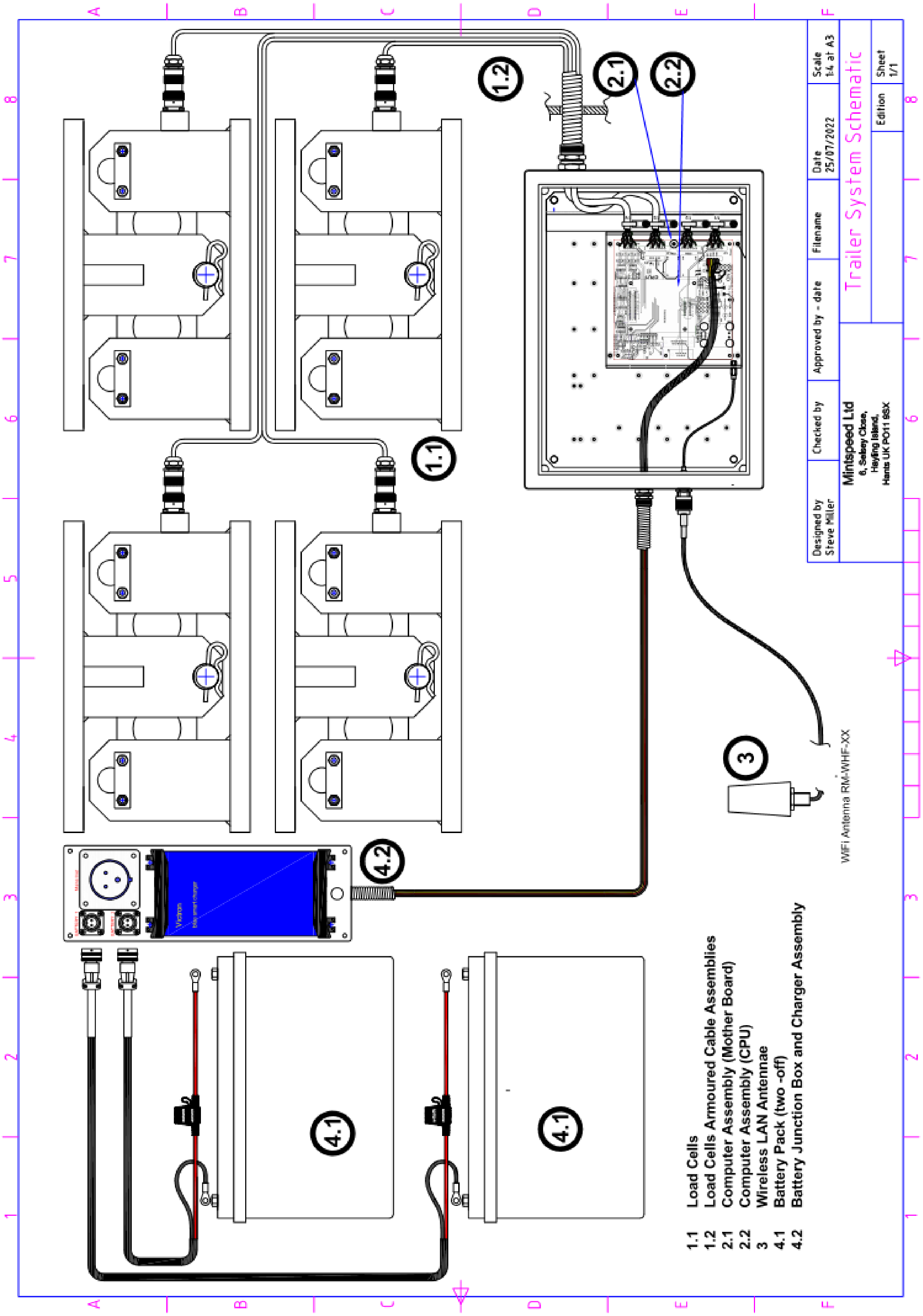
A good management system **MUST** be in place to ensure batteries are not excessively discharged.

For all software integration issues, please see the *PlayStation Manual*

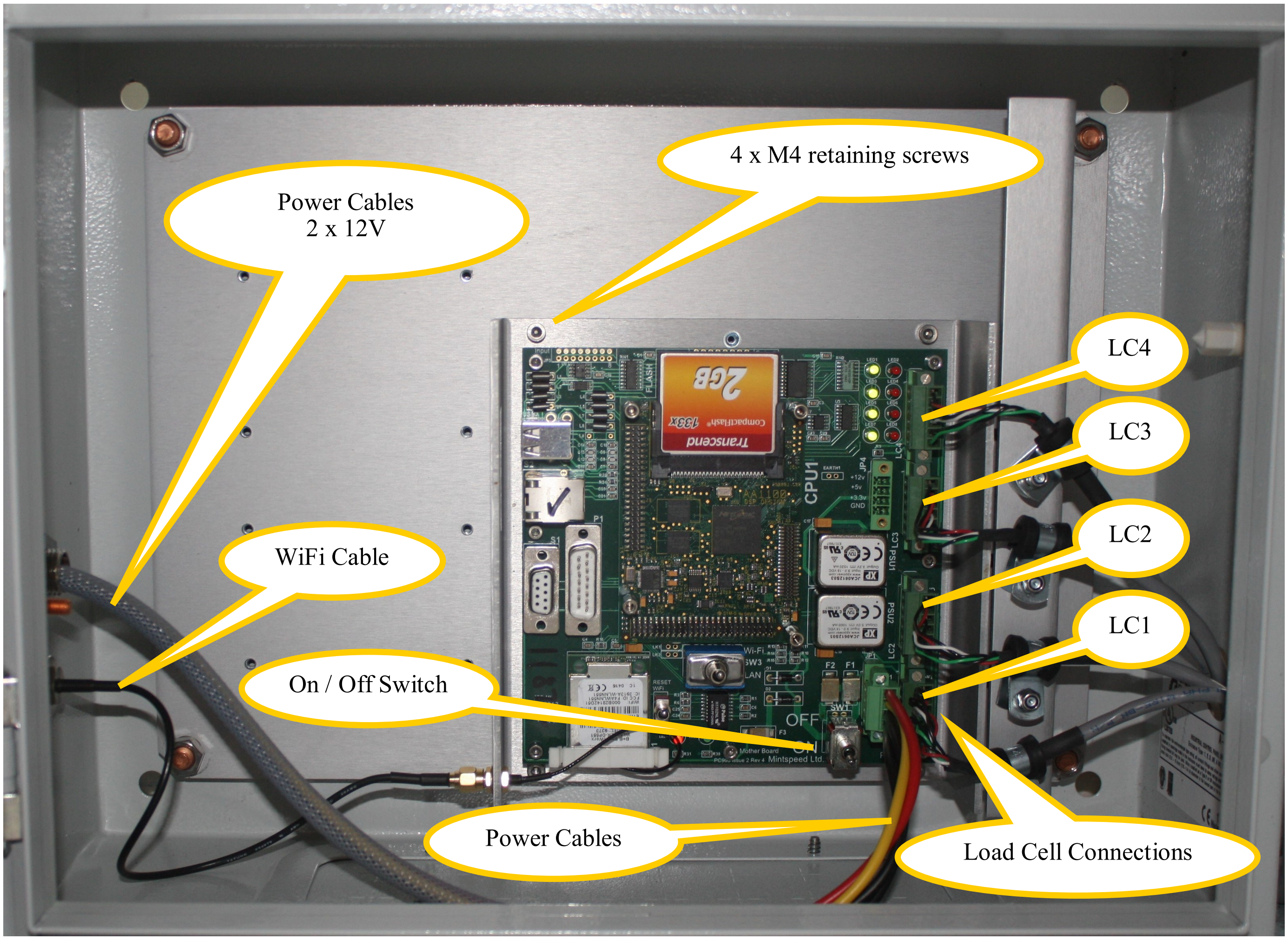
For setting a load cell ID please see the *Load Cell Programmer Manual*

For instructions on using the *ScrapMan Monitor* software for battery management, see the ScrapMan Trailer Software Manual

Trailer Block Diagram



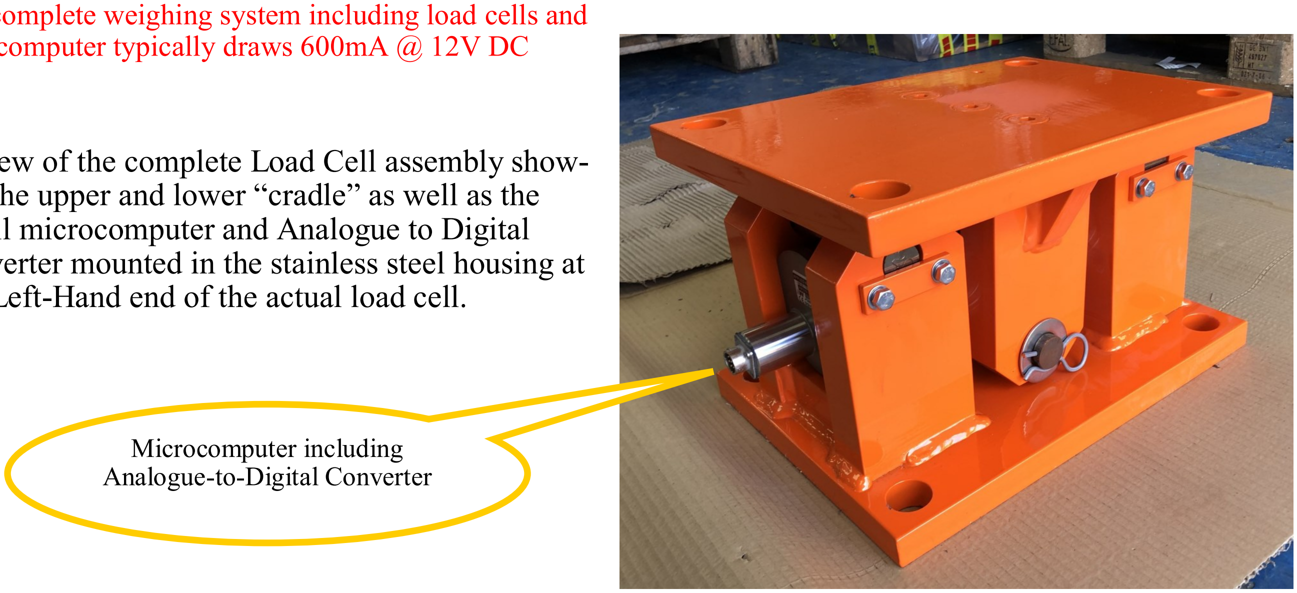
The ScrapMan computer assembly showing the external connections for; Load Cells, Power and WiFi Antenna



1) The computer assembly is held in place by four, M4 x 6mm Socket Screws in each corner, **do not remove any other screws**
2) All the Green cable connectors are retained in place by screws at either end
3) The antenna connection is via a "pig-tail" coax cable terminating in an SMA connector
4) The application program resides in compact FLASH memory

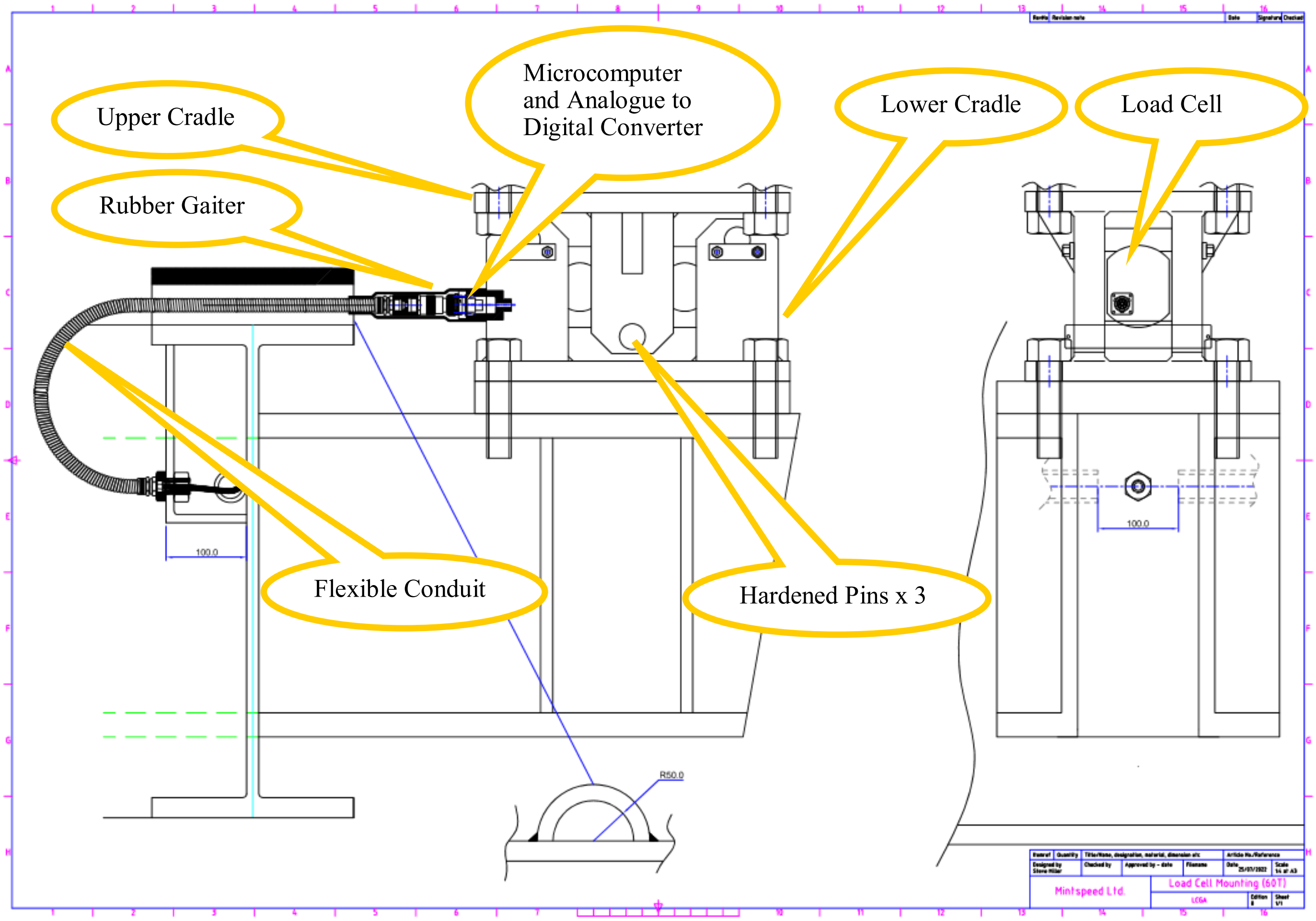
The complete weighing system including load cells and computer typically draws 600mA @ 12V DC

A view of the complete Load Cell assembly showing the upper and lower "cradle" as well as the small microcomputer and Analogue to Digital converter mounted in the stainless steel housing at the Left-Hand end of the actual load cell.

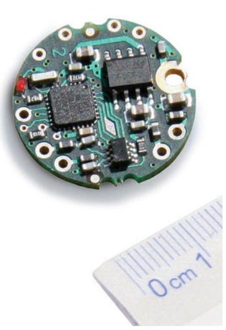


Load Cells and Cables

All load cells are rated at 50% of the **total trailer capacity** to counter the effects of transient shock loads that may be encountered during loading and moving in the scrap yard; they are mounted in a ***cradle*** that allows some limited lateral movement to compensate for uneven terrain. Load measurement is carried out by a microcomputer (Analogue to Digital Converter) fitted in each load cell for converting the load measurement into digital form called a *D-Cell*. Physically, the complete load cell is in three major parts as shown in the following drawing and photographs; the ***load cell*** itself which includes the ***D-Cell*** and connector, the ***lower cradle*** and ***upper cradle*** mounted between the chassis and weighing platform. The load cell is held captive in the cradle assembly by hardened pins which in turn are held captive by small plates. The complete load cell assembly should be periodically cleaned to prevent a build-up of dust and mud which can form a concretion hard enough to affect the measured weight if not removed.



The ***D-Cell*** (shown below) is very small microcomputer housed in the machined, stainless steel cylindrical enclosure at the inboard end of the load cell, this ***D-Cell*** module includes the following functionality;
Strain Gauge Amplifier that conditions the analogue voltage from the strain gauge itself
Analogue-to-Digital Converter (ADC) that digitises the analogue signal from the strain gauge amp
Microcomputer that orchestrates sample rate, and all communications functions - RS485 interface
Non-Volatile memory for holding actual load cell calibration values, Baud Rate etc. etc.

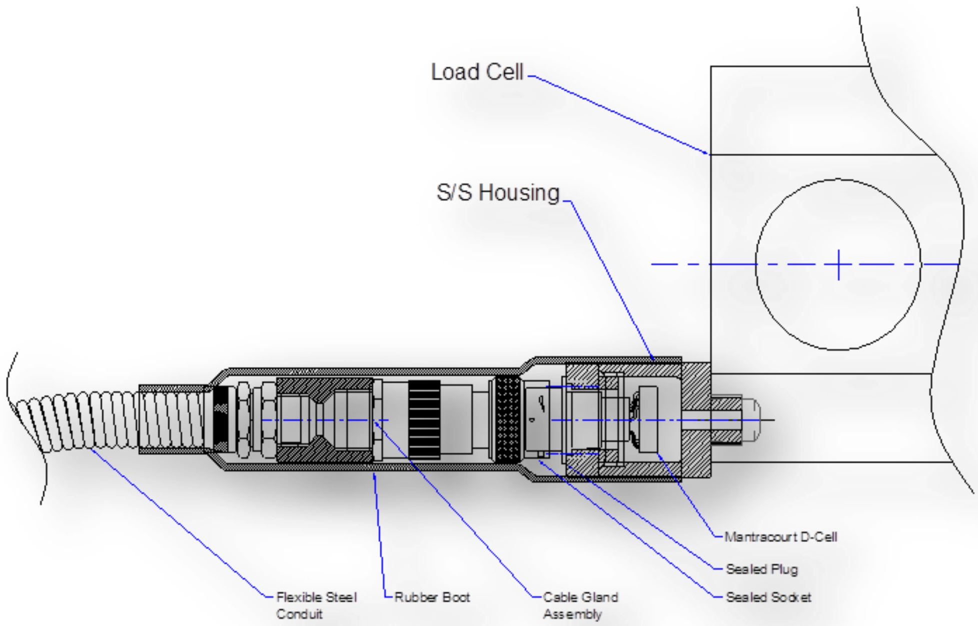


Each load cell and its associated ***D-Cell*** are irrevocably tied together during factory calibration with settings of ***zero load*** to ***Full Scale Deflection*** (depending on the Trailer Load Rating) in 10Kg increments) retained in the non-volatile memory. Consequently, they are effectively *digital* in that no additional calibration or scaling should be required on installation or replacement.

This laboratory calibration is to a very high standard that would be virtually impossible to replicate or duplicate in the Scrap Yard.

There is some provision for on-site minor adjustment (see Checking and Adjusting Weighing System in the Utilities Section) but this should NOT be undertaken lightly and without first reading the ***Calibration Notes*** document. Periodic *checking* can be done whenever required.

Sectional detail of D-Cell housing in Load Cell



60T Load Cell with the weighing platform in-situ showing 3 retaining pins with R clips and washers.

The R clips and washers can be removed and if the weight is taken off, this will allow removal of the retaining pins and will permit the load cell to be slid out of the cradle.

Apart from a “car-jack” to take the load of the platform, only small hand tools are required.

N.B. It is good practice to periodically clean the load cells from any debris. Any build-up of detritus that affects the deflection of the load cell will also affect the accuracy.

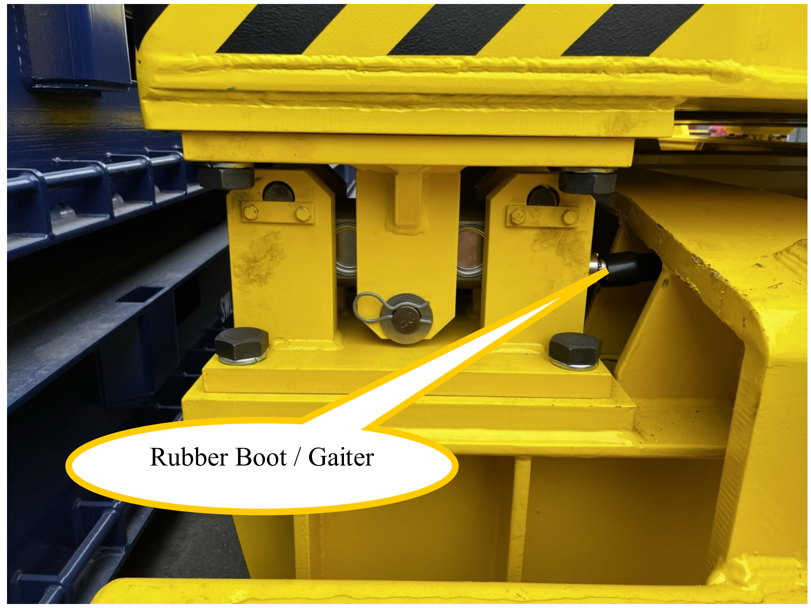
Load Cell Armoured Cables

Six-core (3 x *twisted pair*) screened cable is used to connect the load cells to the central computer and to prevent damage this is ducted in heavy duty steel tube welded to the chassis. The final half metre cable run from the chassis to individual load cells is sheathed in flexible steel conduit with waterproof connectors used to make the final connection to the load cell. The complete connector assembly at the load cell is sheathed by a rubber boot and this is illustrated in the previous section drawing.

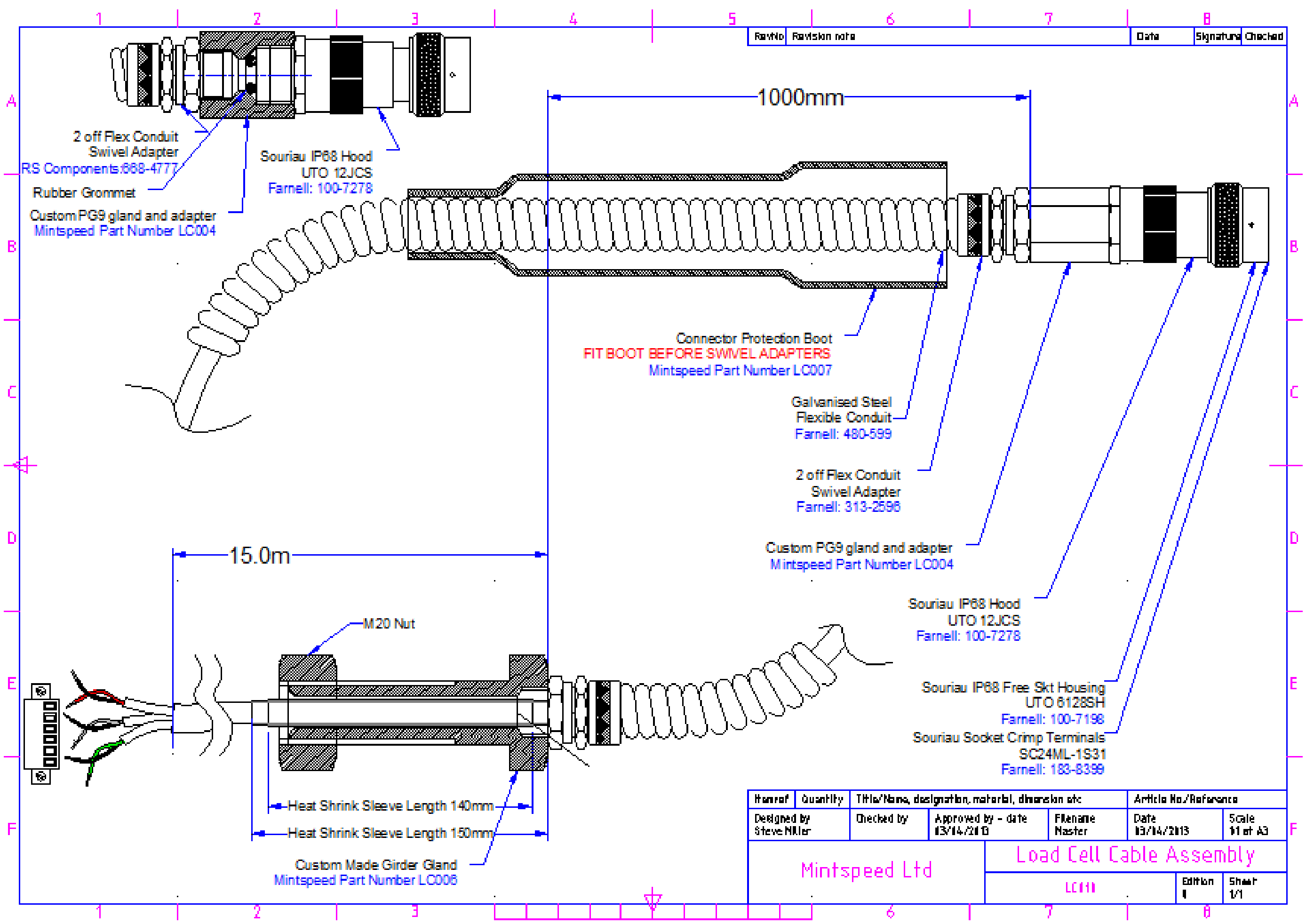
The Load Cell Cable is protected with a flexible steel conduit running from the chassis to the load cell.

The waterproof connector is under the black rubber boot. This area should be cleaned carefully before the rubber gaiter is slid backwards and the connector unplugged. Any dirt or grit may contaminate the contacts and cause intermittent load readings.

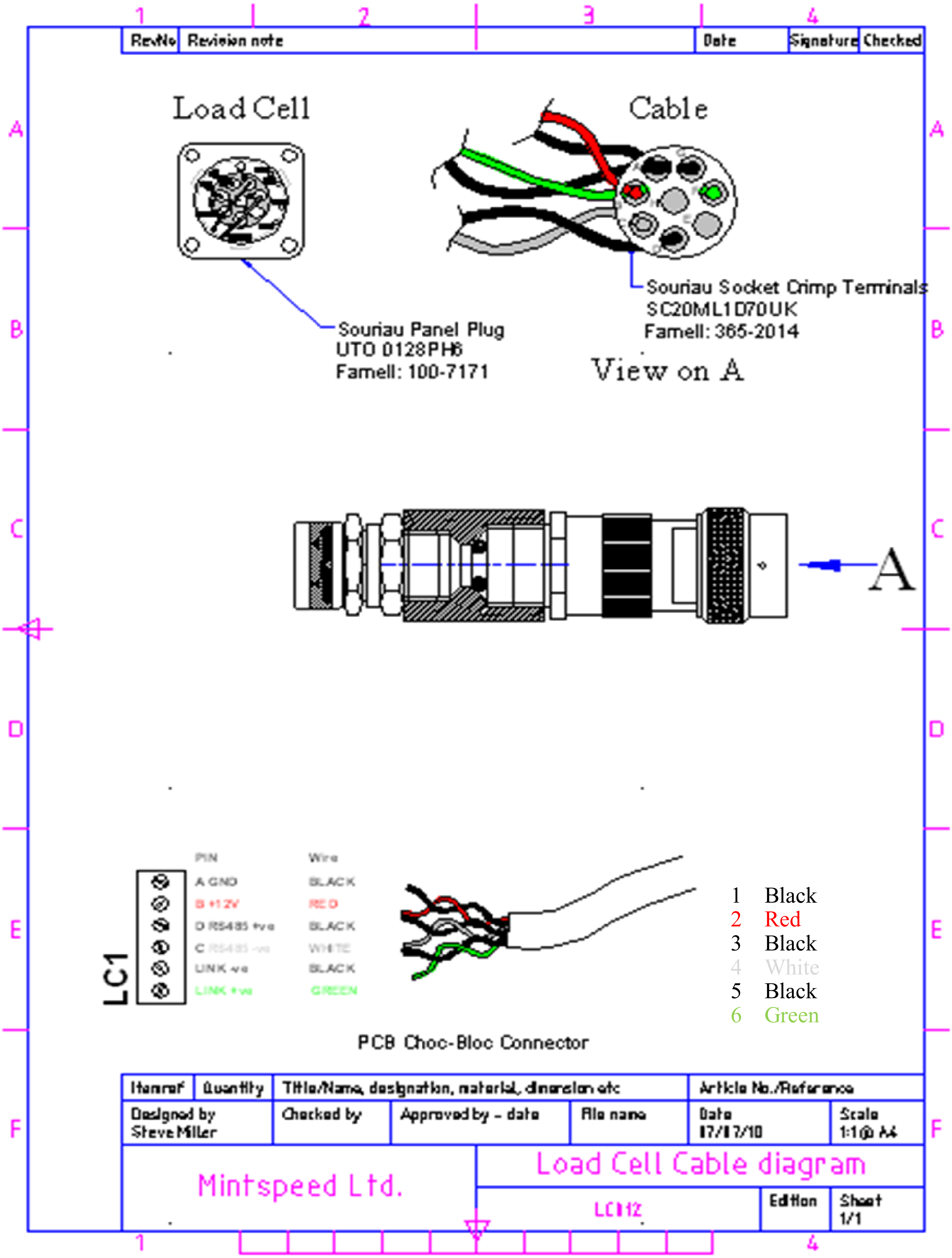
Picture shows 60T load cell



Cable Assembly Drawing



Load Cell Connector Assembly and wiring detail



The Computer Assembly

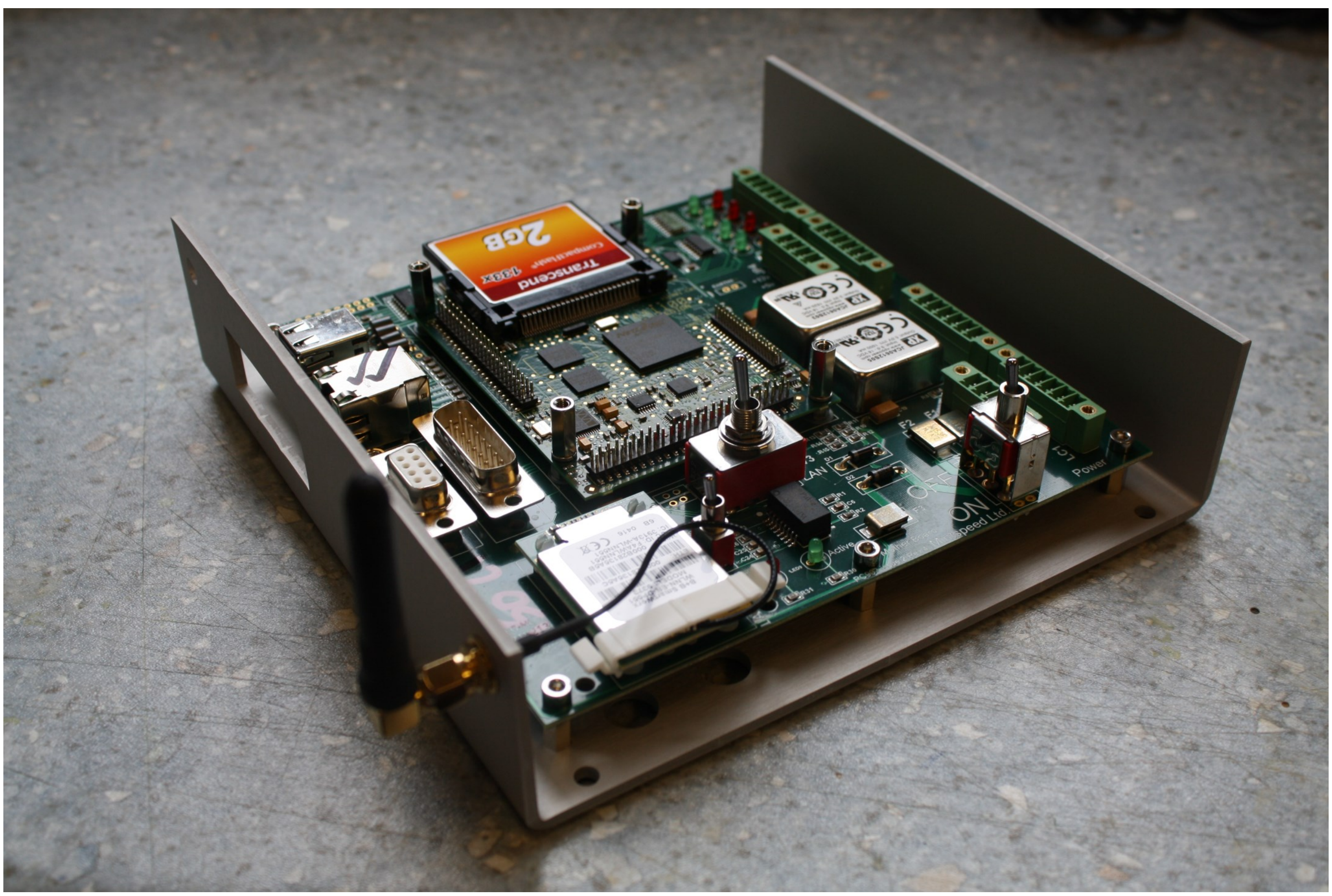
This comprises two separate sub-assemblies mounted to a small aluminium chassis and this in turn is bolted onto to a plate which is part of a pressed steel enclosure with rubber, shock-absorbing mounts.

The Mother Board. This provides a focal point for all the wiring and interface to all the peripheral systems required and includes, Power Supplies, Wireless LAN, Ethernet, USB and two serial com ports; not all of these are actively used. It also supports and provides connectivity to the CPU board which is an embedded PC with Windows CE operating system.

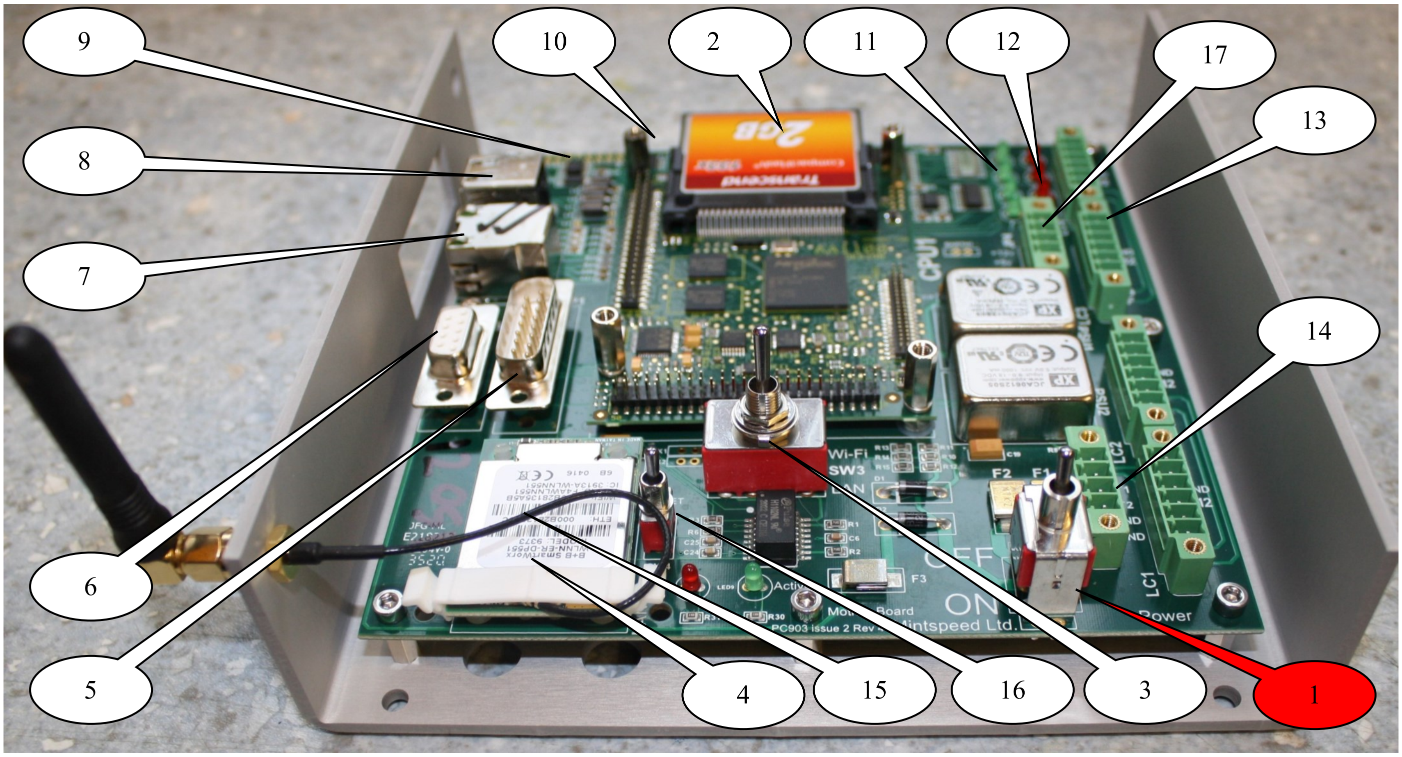
The CPU board. This PC manages the entire system housekeeping including external communication. The application program resides in CompactFlash Memory (2 GB or 4GB) so that if the computer assembly is changed, **the existing Flash Memory must be put into the new board**. In addition to the application program, the Flash Memory also includes the WiFi parameters which allow it to connect and communicate on the WiFi network. The CPU board also includes an Analogue to Digital Converter which is used to measure the battery voltages which can be viewed using the utilities function.

The embedded PC (CPU card) SHOULD NOT BE REMOVED from the Mother Board unless authorised by Mintspeed; there are a number of extremely delicate components beneath the CPU which could be irreversibly damaged by static if handled incorrectly. In the event of a fault, the **COMPLETE ASSEMBLY** (as illustrated in the following photograph) should be returned as one unit.

The application program performs all the mathematical processing to correctly sum all four individual load cell readings, apply damping etc. Furthermore, it operates the LEDs which indicate the load cell status and other operational functions and also orchestrates the WiFi access.



The computer features.



1) **On/Off Switch** — **Main Power Feed from the batteries**
2) Compact Flash Card
3) WiFi / Ethernet Selection Switch. — Normally left in the WiFi position
4) Wireless LAN module
5) RS232 Port reserved for Satel Modem — (Not normally Used)
6) RS232 Port — (Not normally Used)
7) USB Port x 2 — (Not normally Used)
8) Ethernet Connector — Normally only used for diagnostics
9) Digital Output — (Not normally Used)
10) Digital Input — (Not normally Used)
11) Green Status LED's indicate correct operation. — (See Trailer Software)
12) Red Status LEDs indicate a possible problem. — (See Trailer Software)
13) Load Cell Connection (Choc-Bloc x 4)
14) Power Connection
15) Pig-tail coax cable connector
16) Factory Reset WiFi switch
17) Auxiliary Power Outlet (+12V, +5V,+3.3V, 0V)

LED Operation

On initial boot the LED's will appear to flash somewhat at random until all four red LED's illuminate. At which point the software goes into its 'find load cells' sequence. Each LED pair (red and green) represents a load cell, the pair nearest the top edge of the board being load cell '1'. If the load cell is found the green LED will illuminate, otherwise the red LED will illuminate. This progresses up through all four load cells and LED pairs. Once all four load Cells are found and the weighing thread starts to poll them the green LED's will flash together. All red LED's will not be illuminated.

Four GREEN flashing LED's indicates normal operation

The ScrapMan computer will not run properly unless it can connect to the WiFi ascribed Network.

Wireless LAN (WiFi) interface used on the Trailer Weighing System is virtually ***identical*** to that used on laptops, Tablet PC's, I-Pads, smart phones etc. and conforms to the same IEEE 802.1.1 a/b/g/n standard, it operates at 2.4 Ghz. However, a chief difference is that all these consumer devices have a ***display*** and some form of ***key-board*** that permits a good user-dialogue to set-up the WiFi to connect with the appropriate network; the computer in the trailer weighing system doesn't have these peripheral device because they are **NOT** normally needed. The trailer weighing system includes a "PC" but a stripped-down version, an ***embedded PC*** with a minimal operating system, ***Windows CE***. This PC and its operating system is perfectly adequate for the task in hand but does have some limitations when connecting to a WiFi network because of the lack of display and keyboard however, this operation is only normally done once on initial installation.

The WiFi in a laptop will scan the airwaves and produce a list of available networks (names, called **SSID**'s) with the associated wireless signal strength; a choice is made and the user will also be required to enter a **password** be-fore gaining access. The principles are exactly the same for the weighing system **BUT** the choice of network and password is buried into a ***configuration file***; this is a text file residing in the compact flash card in the trailer com-puter. The flash card is withdrawn and inserted into a suitable read/write unit and the file called ***scrapman.cfb (see Note)*** is edited with ***Notepad*** or similar to type-in the correct **SSID** (Network Name) and appropriate **password**; security settings are also **pre-ordained.**

ScrapMan.cfb

```
################################
#Following must not be modified
#
################################
#
ftp-server disable
#
################################
#Following must be configured
#
################################
#
wl-region US
wl-ssid scrapman
wl-dhcp 0
#
################################
#Following must be configured
# if DHCP = 0 (disabled)
#
################################
#
wl-ip 123.1.224.214
wl-subnet 255.255.255.0
wl-gateway 123.1.224.200
dns-server1 194.168.4.100
dns-server2 194.168.8.100
#
################################
#Following are example security settings
#
################################
#
pw-wpa-psk scrapman
wl-security wpa2-psk
wl-auth shared
```

The default (factory settings for the trailer) are as follows;

SSID **scrapman**
Password **scrapman**

The Antenna is designed to operate in the open air at 2.4GHZ and is mounted to a bracket at the very front of the trailer roof; this is the safest place for the antenna but inevitably some will get broken. The antenna screws into the base as shown in the photographs. The base is complete with a coaxial cable 2m long that runs from the underside of the bracket to the computer enclosure where it terminates in a "N" type connector.

Batteries are used to power the weighing system and there are two 12V x 110Ah, ***deep-cycle, AGM*** (Absorbed Glass Mat) batteries in the compartment in the right-hand side of the swan-neck, These can be charged internally using the in-built charger or, if required, the batteries can be removed and charged from an external charger. The two batteries are *effectively* connected in parallel but the termination on the mother board includes ***diode protection*** to prevent a *good* battery from charging a *bad* one. Each battery has flying-leads with a Bayonet-style, 2 pole, ***MIL spec*** connector; these connectors are polarised to ensure correct connection and once engaged, the knurled cover must be twisted clockwise into position to lock the connector in place. The Red positive lead includes a 25 Amp Automotive Style fuse holder and fuse link.

Battery Life will be considerably shortened if the voltage is allowed to fall below ABOUT 11.50 Volts before recharging. The weighing system will still work if the voltage drops to 10 or even 9 volts but this may result in irreversible damage and the battery will need to be replaced. Good battery management should be in place to ensure that whilst two batteries are in service, two spares should be charging.

Battery voltage can be inspected by either using an accurate digital voltmeter OR using the Weight Page in the Utilities which can be seen by a PC connected to the Wireless network (See Utilities). Also, battery voltage, together with WiFi connectivity and load cell performance can be checked in Real Time by using the *ScrapMan Trailer Monitor* software.

Battery Pack

The Trailer battery pack (2 per trailer) slide into the right-hand side of the trailer swan-neck as shown below. If both batteries are fully charged the weighing system should operate correctly for between 4 and 6 days before further re-charging or replacement is required although this can be influenced by ambient temperature. If the trailer is going to be unused for a time, the computer should be switched off to conserve power.

Connection to Trailer

The batteries can be ***Hot Swapped***; it is **not** necessary to turn the computer off when changing but if both are changed at the same time, the computer will perform a Power OFF/ON RESET when powered up again.

The battery positions are numbered on the connection box and the ***only significance*** to this is the ID or *assignment* of the reported voltage.
For Example…….
Battery 1;   12.2V
Battery 2;   12.6V

Charging
The compartment in the right-hand side of the trailer swan-neck houses the batteries and charger. The assembly in the centre of this compartment provides a connection point to the trailer computer, mains inlet connector, a low-voltage cut-out system and a battery charger. This is the ***Victron Blue Smart Charger***

A full manual for this charger and the Blue-tooth interface can be found at

https://www.victronenergy.com/chargers/blue-smart-ip22-charger#downloads

When charging the batteries from a mains supply, the battery compartment door MUST BE LEFT OPEN to ensure adequate ventilation.

For charging, and if using the ScrapMan Trailer Monitor software

1) Take the selected trailer "Out Of Commission" this will stop this application polling a trailer unnecessarily.
2) Turn the trailer weighing system computer OFF using the On/Off switch on the Mother Board.
3) Connect a 230V mains supply to the charger on the top, Right Hand corner of the assembly.
4) Using either the charger LED's or a Smart phone coupled to the charger via Bluetooth, check on the charging progress.
5) When fully charged, disconnect the mains supply
6) Switch the weighing system computer On
7) Using the ScrapMan Monitor, put the trailer back "into commission".

Batteries can be charged "Externally" if desired. The battery should be disconnected by turning the outer ring of the green, MIL spec connector to "unlock" it then removing it from the mating connector.

The battery may be removed but **BE WARNED**, they are **HEAVY at 30Kg**

Battery Junction Box Assembly

In addition to being a junction for battery connection and the charger wiring, the Junction Box Assembly includes two devices (shown below) and fitted inside the case. These are connected between the battery output and the ScrapMan computer supply and sense this supply voltage. They will prevent over-discharge of the batteries and will disconnect the out put IF the voltage drops to 11.50 (the fixed threshold is reached).

IF the voltage stays at, or below 11.50V for a total of 10 seconds then the output to the weighing system computer will be cut **for that channel 50 seconds later.**

These devices are "solid-state" and "fixed", there are no user controls.

If the other battery is OK then operation will continue.

PowerTector voltage sensor and cut-out

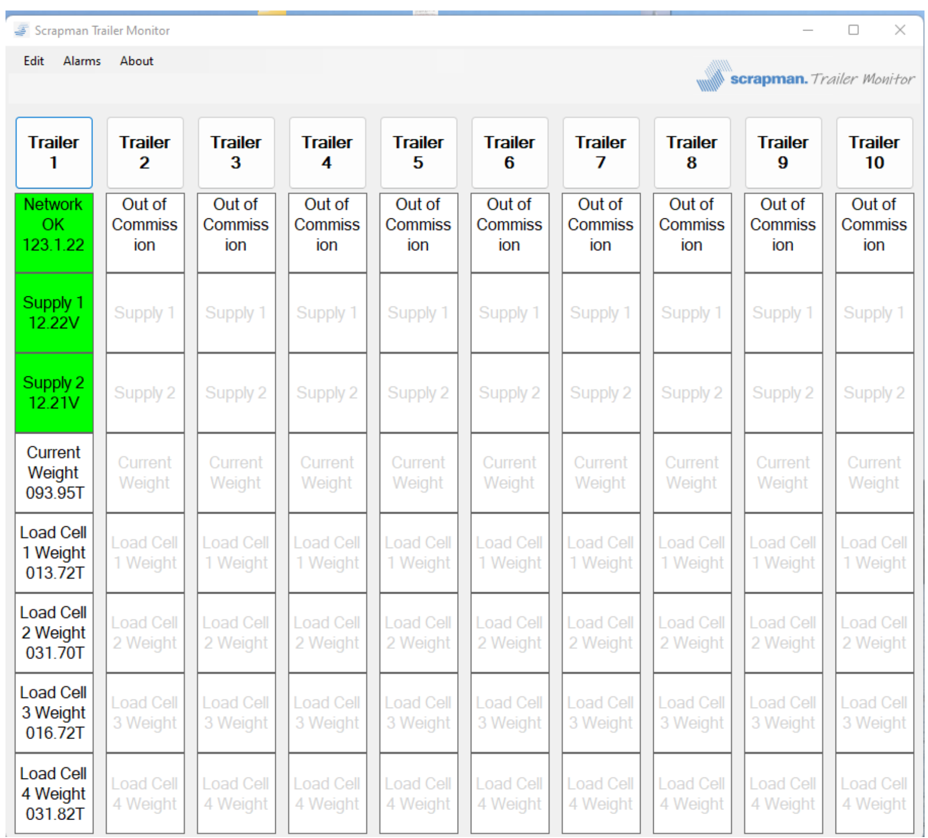
We would strongly advise using our ***ScrapMan Monitor*** Software (screen shot shown below) that will continually monitor the trailer network and report on….

1) Network
2) Load Cells
3) Battery Voltage

This software should be installed to a PC that is connected to the same network as the trailers and should be used by the technicians that maintain the trailers, change batteries etc. This will give advance warning of low battery voltage, network deficiencies, etc. The application can be run stand-alone or as a background task.

Example with a "fleet" of 10 trailers but only one (Trailer 1) is "active" (in commission) at this time.

Trailers can be put in / out of commission to suit service needs etc.



Utilities

The most valuable tool in finding a problem with a weighing system is achieved using the in-built utilities software in each trailer which can be accessed wirelessly using any web browser such as ***Microsoft Edge*** or ***Google Chrome***... With a PC connected to the PLC Wireless network, launch a web browser and in the address box type the URL for the trailer you wish to check. For a new trailer that has NOT had it's settings changed, the following default URL should be used **http://123.1.224.214:5050/** This will show the ***Home Page*** (below). The Utilities of ***Weight*** and ***Tared Weight*** can be left running 24/7 in parallel with the main operation and we recommend that this can be left running permanently and at least, it will monitor battery voltage however, you should NOT attempt to Calibrate whilst the trailer is in use.

The "Weight" Page

Mintspeed Weighing System

About | Weight | Tared Weight | Calibration | Log | Weight (XML)

Current Weights:

	Min	Ave	Max	Curr
Total	93544	93551	93562	93558
SN101	16571	16571	16571	16571
SN102	34722	34722	34722	34722
SN103	16761	16761	16761	16761
SN104	25490	25497	25508	25504

Serial Numbers:

	Serial No
SN101	16890828
SN102	16907959
SN103	16907968
SN104	16907970

Battery Voltage:

	Voltage
Battery 1	12.21
Battery 2	12.20

Current weight: 93.558 tonne

From the tabs, the most useful utilities are;

Weight (Shown left)
Tared Weight (see page 17)
and Calibration

Weight
The Weight Page is the most useful. It can be left running 24/7 it shows all four load cell readings (in lbs) and battery voltage.

Tared Weight
This is most useful for weight checking with dead weights

Calibration
You are strongly advised to NOT to attempt CALIBRATION until you are quite familiar with the procedure and the possible consequences. These are covered in the following ***Appendices***

Appendix 1 *Principles of Mobile Weighing*
Appendix 2 *Software Integration*
Appendix 3 *Calibration Notes*

Mintspeed Weighing System

About | Weight | Tared Weight | Calibration

Current Weights:

	Min	Ave	Max	Curr
Total	25273	25273	25274	25273
SN101	133	133	133	133
SN102	11012	11012	11013	11012
SN103	1603	1603	1603	1603
SN104	12525	12525	12525	12525

Current Weights Table
This show individual load cell readings and is most important for establishing whether or not all the load cells are working correctly. If the trailer is on level ground all four load cells should be taking a share of the load but do not expect them to be equal.

Readings that are negative are suspicious as are readings that are very high compared to the others.

Serial Numbers:

	Serial No
SN101	16834489
SN102	16834487
SN103	16834491
SN104	17541859

Serial Numbers Table
The first column is the number of the load cell on the trailer; SN101 is the front, left-hand side, SN104 is the front, right-hand side. The Serial Number Column displays the serial number of the micro-computer that is in each load cell. If one of these is blank, it may indicate a fault with the cables or a load cell.

Battery Voltage:

	Voltage
Battery 1	12.22
Battery 2	12.24

Battery Voltage Table
Is the readings obtained from the batteries and provides an indication of battery status. Batteries should **NOT** be allowed to fall below 11.50 VDC

You are strongly advised to keep a PC active on the Network and permanently connected to the trailer using the “Weight Page”. As well as showing all the load cells, it also displays the current battery voltage.

Current weight: 25.273 tonne

The ***Tared Weight*** Page

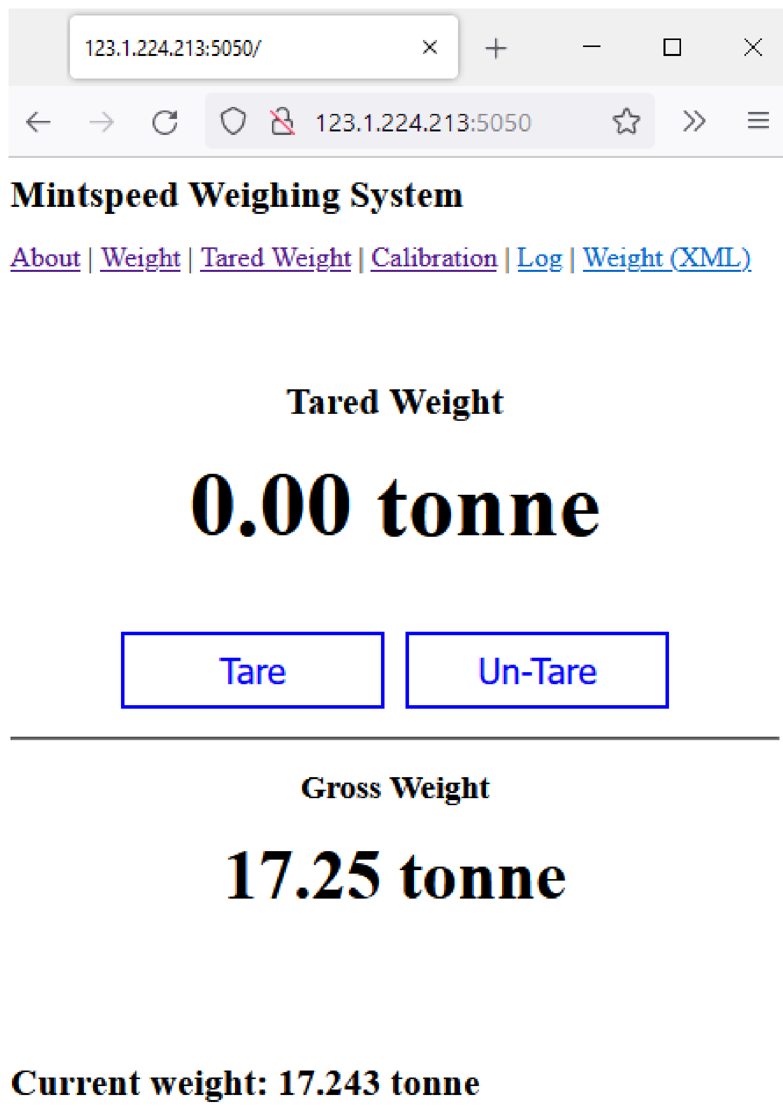
This is the utility that should be used for **CHECKING** the trailer accuracy **NOT** calibration. The principal is straightforward having first ensured the trailer is parked on flat and level ground….

1) Empty and clean the platform
2) Press TARE
3) Using a known test weight, load the weight to the platform and note the reading.

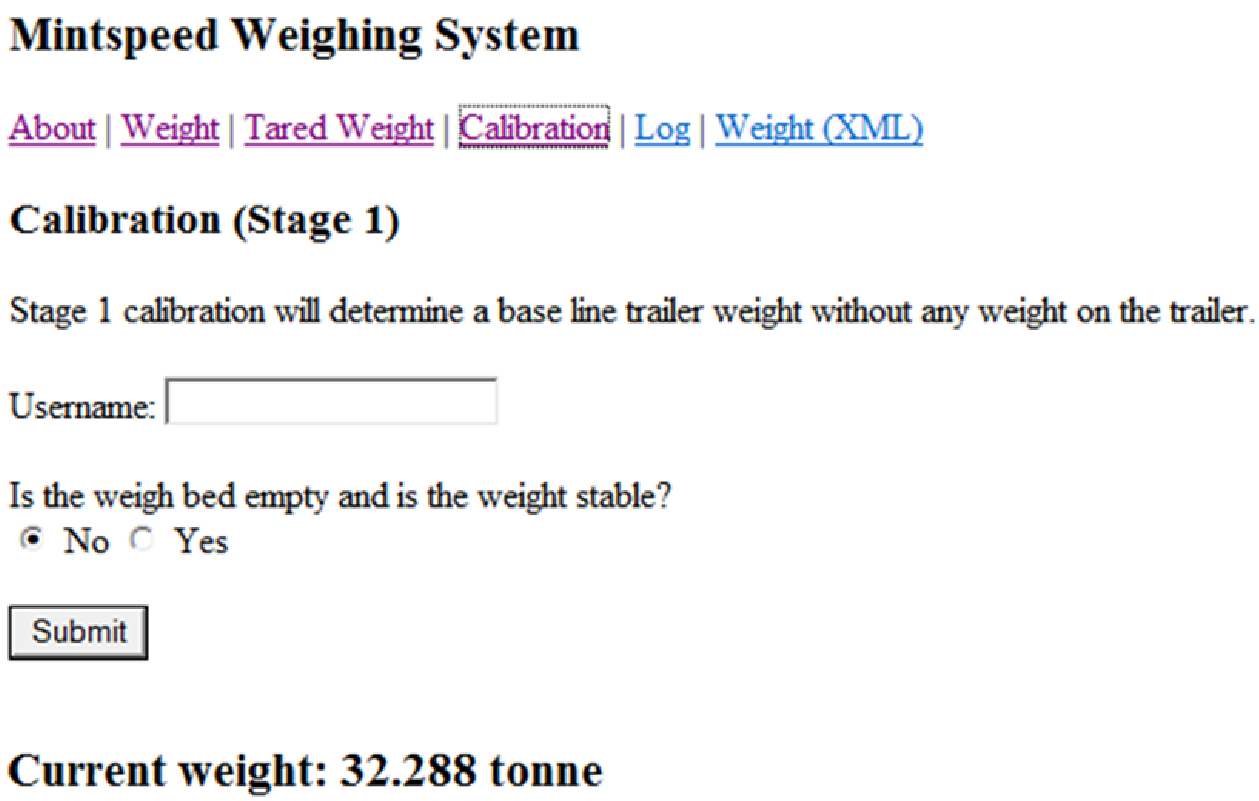
The test weight / weights should be close to the value of full scale deflection of the trailer, NOT a small weight.

If the error is small it will be counterproductive to try and eliminate it, see Appendices

Unless specified when ordering, units are metric Tonnes



The *Calibration* Page



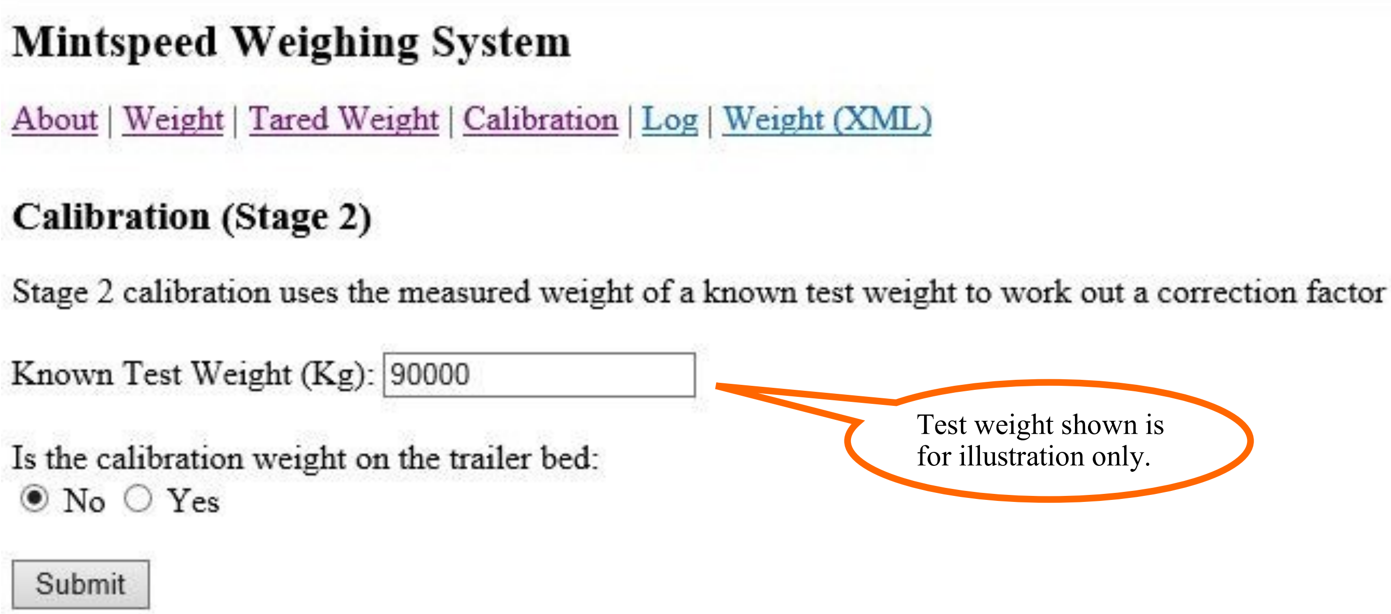
This procedure allows some tweaking of the factory set calibration values, any changes made are within the Scrap-Man computer, **NOT** the load cell. It **should not** be done to eliminate errors from a faulty load cell. The weigh check facility (Tared Weight) should be done first and if there is a problematical load cell discovered, it should be replaced. Calibration should only ever be attempted if the following conditions can be met;

1) The trailer **MUST** be on flat and level ground
2) The test weights **MUST** be close to the rated maximum load of the trailer
3) Using lots of small weights is potentially dangerous; a small number of BIG weights is better
4) Suitable lifting gear MUST be available (melt-shop crane)
5) The weights need to be loaded to the platform symmetrically and close to the Centre of Gravity of the scrap basket

The calibration procedure does NOT alter the calibrated values within the load cell but it DOES change the summed (Total) load that is transmitted back to the host system. The process is done against the application of a known dead weight and this weight should be close to the upper limit of the capacity of the trailer (80-100%). The weight should be applied as close to the centre of gravity of the normal basket position as possible and once complete, the weight will be entered into the CalibrationSettings.xml file in the CF memory under <CALWEIGHT>

1) Open up an Internet session
2) Enter IP address of relevant trailer http://123.1.224.214:5050/ (default from new) followed by Return (Enter)
3) You should get the home page for the trailer as shown previously
4) Select ***Calibration*** and you should get the screen shown here
5) The Username is the name (text) of the person doing the calibration and once entered will be stored in the CF
6) Ensure weighing bed is empty and clean and when stable answer “Yes”
7) Press “Submit”

Do NOT commence a calibration procedure without having read,
and fully understood, the associated *Calibration Notes* document in the Appendices

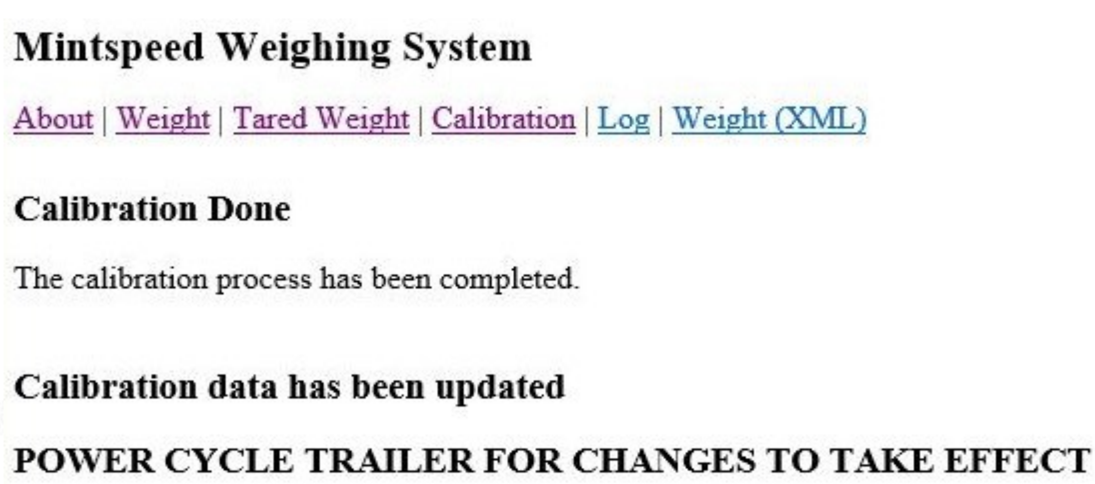


Having entered a username which will be stored in the error log file, you need to enter the test weight if the presented default is not correct and then respond that the platform is "empty and the weight is stable".

Stage 2 requires a known test weight to be added to the platform and that value keyed into the box. THIS WEIGHT NEEDS TO BE AS BIG AS POSSIBLE (80 – 100% of the rated load of the system); this is the ***area of interest***. Anything below about 15 Tonnes is almost irrelevant since that is the normal Tare weight of an empty basket.

The test weight is lowered and once lowered and stable, press **Submit**

You will then see the "Calibration Done" message which also requests that you power cycle (OFF then ON) again to effect the changes.



The *Calibration* Page (Contd.)

Remove the CF card and an inspection of the file ***CalibrationSettings.xml*** (below) will show the ***Gain*** figure to have been changed. By default from new, the Gain is 1.0. It should ALWAYS be **about** 1 +/- if it significantly at variance from 1 then its appropriate to suspect a faulty load cell or possibly a faulty cable.

After calibration, a typical ***CalibrationSettings.xml*** file may look like…..

```
<?xml version="1.0" encoding="utf-8"?>
<Settings>
  <Weight>
    <Gain>0.997329373566339</Gain>
    <UseOffset>false</UseOffset>
    <Offset>0</Offset>
    <!-- Cal weight in Kg -->
    <CalWeight>90000</CalWeight>
  </Weight>
  <Battery>
    <Gain>1.0</Gain>
  </Battery>
</Settings>
```

If you make a mistake, this file can be changed by opening ***CalibrationSettings.xml*** with Notepad and changing the Gain back to 1 from **0.997329373566339**

Before calibration, a typical ***CalibrationSettings.xml*** file may look like…..

```
<?xml version="1.0" encoding="utf-8"?>
<Settings>
  <Weight>
    <Gain>1.0</Gain>
    <UseOffset>false</UseOffset>
    <Offset>0</Offset>
    <!-- Cal weight in Kg -->
    <CalWeight>90000</CalWeight>
  </Weight>
  <Battery>
    <Gain>1.0</Gain>
  </Battery>
</Settings>
```

The default (Factory) setting for ***Weight GAIN*** is 1.0

Load cell Replacement (Mechanical)

If a load cell is deemed to be faulty it is first necessary to remove the basket if one is in place; obviously, this can usually only be done in the melt shop using the overhead gantry crane. The trailer electronics should be switched off and the batteries disconnected until the configuration process. It is not usually necessary to remove the platform.

Cleanliness

There will inevitably be a large build-up of lime dust and general mud that may have produced a concretion around the load cell mountings and cable exit. It is important to carefully and thoroughly clean this area **BEFORE** starting dismantling. Cleanliness is essential to prevent contamination of the connectors with dust and grit which will certainly cause erosion of the gold contacts and hence adversely affect system reliability and longevity in the long term.

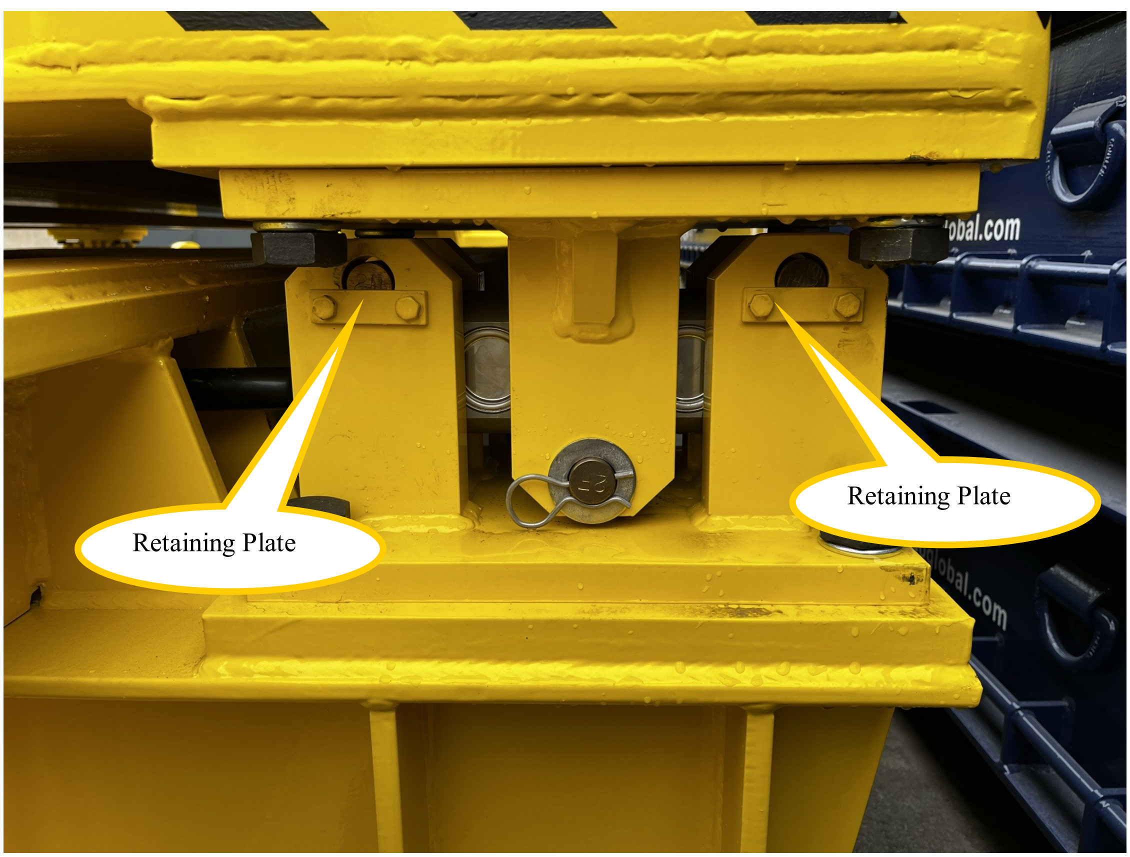
Dismantling

Mechanically, load cell replacement is very simple; it is NOT NECESSARY to remove either upper or lower parts of the cradle, consequently it is likely only a screw car-jack and a good pair of pliers or mole-grips is required. Having cleaned the area…

1. Slide the rubber boot back down the flexible conduit from the load cell connector assembly
2. Grasp the connector locking ring and push inwards, simultaneously twisting anti-clockwise to release the connector. It is a "Bayonet" type locking.
3. Temporarily, put the connector end of the cable in a clean bag of some description to keep it free of dust / mud.
4. Use a screw or hydraulic jack to lift the weighing platform in the immediate vicinity of the faulty load cell. It is only necessary to take the weight off the load cells so that the three pins can be removed
5. Remove the small retaining plates from one side of the load cell and withdraw the hardened pins
6. The load cell can now be removed from the cradle by sliding it out.

Use the opportunity to clean the cradle and surrounding area and apply grease.

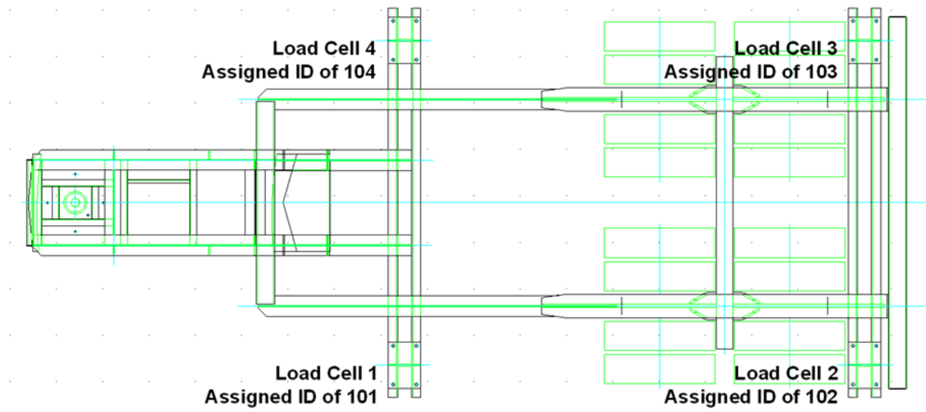
Reverse the above procedure with a new load cell.



Load cell Replacement (Configuration / Software)

Each load cell on a trailer must have a unique identity (ID) so that the software running on the trailer can identify which of the 4 load cells is which.

The diagram below shows a plan view of a trailer and indicates where each of the 4 load cells are located along with the ID which must be assigned to the load cells.. Load Cell 1 (ID 101) is the front, left-hand side going anticlockwise to Load Cell 4 (ID 104) front, right-hand side.



All load cells returned from the factory, whether new or refurbished, will be supplied with an ID of 1 and so the load cell will need to be reprogrammed with the ID corresponding to the position on the trailer where it will be located.

Note: If replacing more than 1 load cell on a trailer it is important that they are configured one at a time and that you start by configuring the load cell with the lowest ID. For example if load cells 2 and 3 are being replaced then load cell 2 must be configured before load cell 3. Furthermore load cell 3 must not be electrically connected to the trailer computer until after load cell 2 has been configured.

Process for configuring the ID of a load cell:

1. Ensure that the trailer computer is powered off.
2. Connect the new load cell to the appropriate port on the computer motherboard (see diagram on page-4, trailer plan on this page and notes above regarding which load cell and where to connect it)
3. Turn on the power to the trailer computer.
4. The software will now scan the system for a new load cell, i.e. a load cell with an ID of 1 and reprogram it to the correct ID. This semi-automatic process takes about 5 minutes
5. Turn off the power to the trailer computer, wait a few seconds and turn it on again.

Repeat steps 1 – 5 for each load cell that is being reconfigured.

Note, if the load cells are configured in the wrong order or you attempt to configure 2 or more load cells at the same time then the configuration will fail, leading to undefined behaviour of the system which will require support from Mintspeed to rectify.

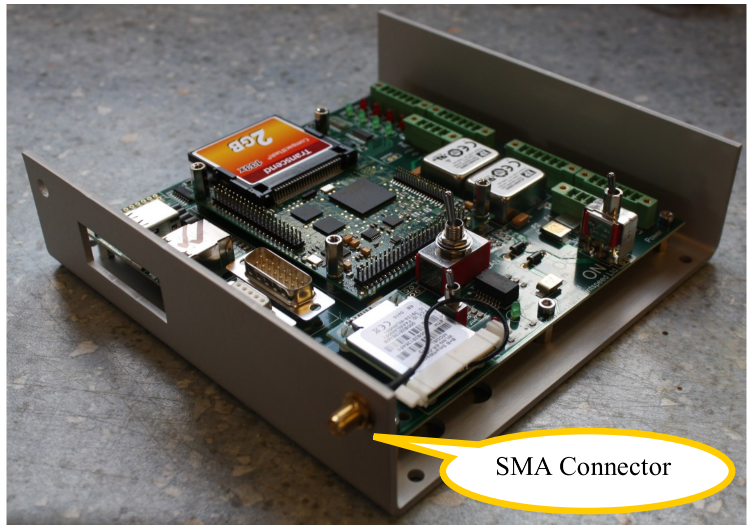
Any new or previously used load cell that is being install onto a trailer must have an ID of 1 prior to being configured or else the system won't recognise the new load cell as requiring configuration. Load cells can have their ID checked and reconfigured to ID 1 by using the ScrapMan Load Cell programmer and Mantracourt software as described in the ***ScrapMan Load Cell Programming Manual***

Replacing the complete computer mother board assembly

Due to the integrated nature of the construction of the mother board and CPU board assembly it is considered ESSENTIAL to replace the whole assembly (as shown in the photograph on right) NOT individual parts. Apart from the CF memory which should be retained, this complete assembly should be returned in the event of a fault.

Observe static electricity precautions.

The Gold-Plated SMA WiFi connector should be unscrewed.



1) Switch the computer OFF and un-plug **BOTH** batteries in the battery compartment.
2) Using a small screwdriver, undo the retaining screws in the ends of the green choc-bloc connectors and unplug them; this is 4 x load cell and 1 x power
3) Unscrew the gold-plated SMA WiFi connector
4) Using an Allen Key, remove the four M4 Hex socket screws in each corner of the CPU assembly
5) Remove the assembly and replace with a new unit
6) Remove the Compact Flash Memory card from the faulty CPU and, taking care to ensure correct alignment and polarity, insert into the socket of the replacement CPU board.

Reverse the above instructions ensuring the right wires go in the right places.

From new, the load cell cables are all individually labelled as follows;

1/1	Trailer 1, Load Cell 1
2/1	Trailer 2, Load Cell 1
3/3	Trailer 3, Load Cell 3
4/1	Trailer 4, Load Cell 1 etc. etc.

The wiring is from "6-core, twisted-pair" cable. That is, three pairs of wires with each pair twisted together. It is very important that these are not mixed up or crossed-over. The connections are as follows

GND	0 Volts	Black	
+12	+12 Volts	Red	This is one pair
D	+RS485	Black	
C	-RS485	White	This is one pair
F	-ve sense	Black	
G	+ve sense	Green	This is one pair

Once complete, the final stage is configuration of the WiFi module on the mother board. This is a semi-automatic process that uses configuration data held in the FLASH memory and is accomplished as follows;

1) Press and hold down (it is a sprung-loaded ***biased*** switch) the WiFi RESET switch
2) Simultaneously, switch the computer ON using the On/Off switch.
3) Wait about 15 seconds, this will flush the old WiFi settings away.
4) Release the WiFi RESET switch and turn the computer Off
5) After a moment, turn the computer back on and the WiFi self-configuration process will commence.
6) This process can take several minutes or more; when all four green LED's start flashing, the unit should be power cycled **Off** then **On** again before use.

Appendix 1 Principles of mobile weighing of scrap material

The most important thing to bear in mind is that the ***principle*** of weighing 200T of scrap steel is ***exactly the same*** as a cook combining ingredients for a recipe using kitchen scales - even the word ***recipe*** is used although sometimes the description ***hot metal order*** or similar is also used in the steel industry. It's exactly the same, a list of ingredients with a quantity for each item…..

If a cook has a recipe as follows;

Flour	250gm
Salt	5 gm
Butter	20gm
Raisins	50gm

The cook puts a mixing bowl on the scales and presses **TARE**, then pours in flour until the display reads 250gm.
The cook presses **TARE** and adds salt until the display reads 5gm
The cook presses **TARE** and adds butter until the display reads 20gm
The cook presses **TARE** and adds raisins until the display reads 50gm
Etc. etc…….

The Trailer weighing system operates using **EXACTLY** the same principle but with bigger weights and material is added by ***Crane, Front-Loader*** or ***Chute***; the ***recipe*** is normally held and issued from a ***Host*** computer system.

Furthermore, the weight **DISPLAY** and **TARE** functions are **NOT** mounted directly on the trailer for a number of reasons;

1. The weight display **MUST** be big enough to be seen from a crane cab.
2. A display that is big enough to be visible will take too much battery power
3. A display that is big enough **WILL** be damaged by falling scrap
4. A **TARE** function on the trailer would mean the crane driver getting in and out of the cab to press **TARE** between loads.

Display and other functionality (Tare) is usually done via a host using a PC terminal in the crane cab.

The ***Host System*** would process the recipe and issue information to Tractors and Cranes via a WiFi network and include such details as ***Material Description***, ***Target Weight*** and ***Location.*** Weights would be measured by the weighing system and reported back to the host.

At the completion of each loading cycle, the ***Actual Weight*** (what was actually loaded) is sent back to the Host system as part of the record of the contents of that scrap basket.

Unlike a static weighbridge, a mobile weighing system requires the load cells to be used as structural chassis members to support the weighing platform. Uneven and sloping ground can cause some chassis twist and induce superfluous forces that influence load cell measurements.

It is therefore **very important** to follow the recommended procedure shown on the following page for getting load data from the trailer, this will prevent these induced errors

Any software MUST follow the principles described above; you CANNOT treat the mobile weighing trailers the same as you would a static weighbridge.

200T Trailer with scrap basket being loaded by a Crane

Appendix 2 Software Integration

For the most accurate weighing results, the following software methodology should be adopted in relation to the "dialogue" between a host computer system and the trailer weighing system

HOST refers to commands / requests from that Host Computer System

In the Melt Shop at the **START** of the loading cycle
With the Trailer parked on flat and level ground and disconnected from Tractor, prior to loading empty scrap basket, the **HOST** should check for weight stability and get the current empty weight (**W1**)

The empty scrap basket is lowered onto the trailer, the **HOST** should check for stability and get the new current weight (**W2**). **W2** minus **W1** equals the weight of the scrap basket and if there is a look-up table of actual basket weights **and** the scrap baskets are identified, this is a good time to perform a ***sanity-check*** of the trailer accuracy. This means that if a particular empty scrap basket is **supposed** to weigh (for example) 45,245 Kg and it actually measures 32,045 Kg it could be indicative of a faulty load cell.

In the Scrap Yard

1) The Tractor will tow the trailer and empty scrap basket to first loading area, the Tractor then lowers trailer to ground and disconnects. The **HOST** then checks for stability and gets the new current weight (**W3**). **W3** should be **SIMILAR** to **W2** but it's unlikely to be the same due to vagaries with the site and the chassis twisting and bending; these issues are explored elsewhere: **it does not matter if they are not the same**.

2) The Crane driver then loads material in accordance with recipe instructions from the **HOST** until the **target load** for the layer has been achieved then the **HOST** checks for stability and gets new current weight (**W4**). **W4** minus **W3** equals the weight of material for that layer (called for example **WL1—*Weight Layer 1***) **and is the load data that should be processed by the HOST.**

3) **WL1** should be stored in the **HOST** along with the Material Description, stock location etc. etc.

Operations 1,2 and 3 are repeated for as many layers that are used and the weights of each layer (eg: **WL1**, **WL2**, **WL3** ….. **WLn** where "n" is the final layer are **ADDED** together to produce the final net **TOTAL** weight, **WT**:

WT = **WL1**+**WL2**+**WL3**+…….**WLn**

All mobile weighing systems adopt the same procedure described above—effectively ***PSEUDO TARING*** the weighing system before starting a new layer and recording the difference between **START** and **FINISH** for each layer.

N.B.
A potential source of inaccuracy is the build-up of debris (scrap) on the weighing platform due to ***spillage*** when loading; it must be remembered that if scrap is on the weighing platform **IT WILL BE WEIGHED**. The same is true of scrap that is caught on the scrap basket and does not fall into the furnace it will all be weighed and reported back to the host system. This scrap material **WILL NOT GET LOADED TO THE FURNACE and will affect the apparent yield.** This has been observed in actual use to be up to 2 tonnes and there is no way the trailer computer or the host computer system can account for this; it requires visual inspection and physical intervention to handle. However, any shortage is only *apparent* since the material hasn't been lost—it's still on the trailer or if it's fallen off, it's still in the scrap yard.

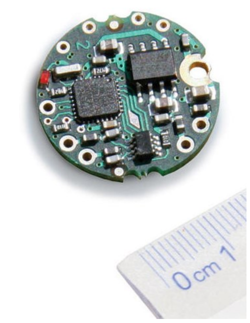
Debris can also build up around the load cell and this can affect the performance. The most usual place is under the centre strut of the upper part of the load cell cradle as shown in the picture on the right. Under full rated load, **the load cell can deflect by up to 2mm (1/8th inch**) and anything that inhibits that deflection will also seriously affect the apparent accuracy. Debris can either be solid (scrap items) or a build-up of lime dust which can form a concretion if allowed to get wet and then subsequently solidify.

Appendix 3.1 Calibration Notes; how load cells work

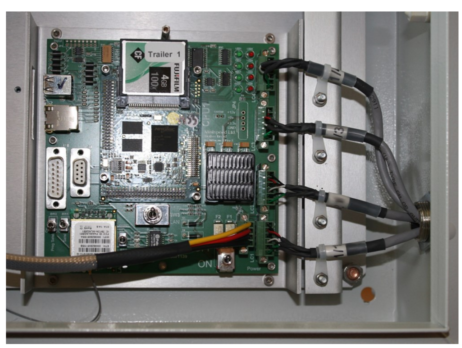
This document describes how load cells work and explores the concepts involved in calibration…..

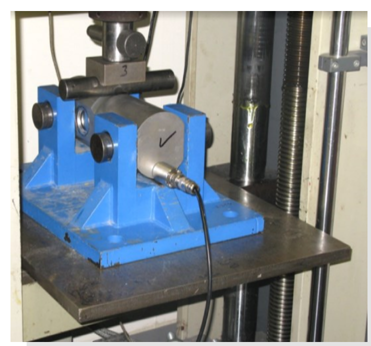

Double Shear Beam Load Cell

Introduction: contemporary weighing systems use ***load cells*** to measure force, these are billets of s/s alloy machined in such a way as to deliberately include a weak area that is intended to deform when the load cell is subjected to a mechanical force. The area of deformation has a small electronic circuit called a ***strain gauge*** bonded to it and this device has a small excitation voltage applied to it; there are two other terminals on the gauge for ***sensing***. The voltage between the sense terminals changes with respect to the load applied to the load cell and in direct proportion. In theory, a voltmeter could be used to measure load but it would be necessary to convert the voltage reading (expressed in mV) into lbs, grams, Kg or Tonnes. However, usually this function is accomplished with the use of external amplifiers, computers or instrumentation.



The load cells used in Seacom trailers are effectively ***digital***. They include all of the features mentioned above but in addition also include a small but powerful microcomputer (see left) to convert the minute voltage changes into meaningful ***Engineering Units*** (lbs, grams, Kg, Tonnes etc.). This microcomputer is actually fitted inside a s/s housing at the end of the load cell itself (see below left) and the load data is transmitted in RS485 format to the central embedded PC on the trailer (below centre).





This design philosophy allows *pre-calibration* in a test laboratory where the highest standards of accuracy can be obtained. The load cell is loaded to a test rig (above right) and using some specialist software on a PC connected to the microcomputer, the values of ***ZERO*** load and ***Full Scale Deflection (Span)*** are set with the appropriate numeric value as the test load is applied. With no mechanical load a numeric value of ***0*** is entered and with rated maximum load (e.g. 100.00 Tonnes) a numeric value of ***100,000*** (Kg) is entered. These values define ***the slope of the graph*** of ***physical load*** against ***load value*** transmitted and are stored in non-volatile memory within the load cell microcomputer; these values remain indefinitely unless deliberately changed and this action would only normally be done in a test laboratory with suitable facilities to those used in the initial calibration.

It is important to bear in mind that due to the very large test weights required and the challenging environment of the Steelworks, it would be virtually impossible to replicate or duplicate this standard of accuracy in the Scrap Yard.

All the load cells are all wired back to the embedded PC (above centre) which consolidates the individual readings by sequentially and constantly polling all four cells and ***adding*** the individual readings to provide a ***total weight***. There are other features in the software for smoothing and damping the load but in essence, the central trailer computer adds the individual load cell readings and organises the transmission to an external host system via WiFi.

Appendix 3.2 Calibration Notes, sources of error

Potential Sources of error

Aside from a load cell failure which is usually quite obvious and necessitates replacement, there are several possible sources of weighing errors;

1) Build-up of Debris (a)

Debris can build up around the load cell and this can affect the performance. The most usual place is under the centre strut of the upper part of the load cell cradle as shown in the picture on the right. Under full rated load, **the load cell can deflect by up to 2mm (1/8th inch**) and anything that inhibits that deflection will also seriously affect the apparent accuracy. Debris can either be solid (scrap items) or a build-up of lime dust which can form a concretion if allowed to get wet and then subsequently solidify.

2) Build-up of Debris (b)

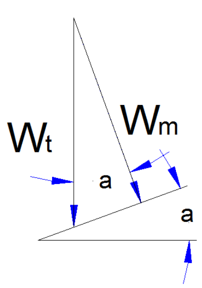
Another source of problem is the build-up of debris (scrap) on the weighing platform due to ***spillage*** when loading; it must be remembered that if scrap is on the weighing platform **IT WILL BE WEIGHED**. The same is true of scrap that is caught on the scrap basket, it will all be weighed and reported back to the host system. Nevertheless, this scrap **WILL NOT GET LOADED TO THE FURNACE** There is no way the trailer computer or the host computer system can account for this; it requires visual inspection and physical intervention to handle.

Depending on how the external software adds the material weights in the host system this ***apparent loss*** may affect the ***apparent yield***. The shortage is only ***apparent*** since the material hasn't been lost—its still on the trailer or if its fallen off, its still in the scrap yard. By remote monitoring of the weighing system using the web browser, debris on the platform has been observed to weigh up to 2 or 3 Tonnes. This is deduced by a comparison of ***TARE Weights*** for a particular scrap basket whose empty (TARE) weight seems to ***grow*** each time the empty basket is put back on the trailer. Clearly this doesn't happen but if the platform is cleaned off, the TARE weight of the basket reverts to what it should be.

3) Uneven Terrain

If the trailer is sloping or parked on uneven terrain sufficient to induce a chassis twist, errors can be introduced due to the alignment of the load cells plane of operation (normally at right-angles to the plane of the chassis) with respect to the vertical force of gravity. A 5° slope can introduce an error of 0.4%; a 10° tilt, although very unlikely, would introduce an error of 1.5% in all cases, the weighing system would **under-read**. At 10° slope the trailer would need 101.50T loaded to display 100.00T. In the load vector diagram shown below, left, the ***Measured Weight*** (***W_m***) is reduced because the load cell is at an angle; the formula to calculate that measured load is; ***$W_m = W_t \times \text{Cosine } a$*** where ***$W_t$*** is the ***True Weight*** and ***a*** is the Angle of tilt.

This potential problem is <u>exacerbated</u> if the trailer is sloping <u>during</u> the calibration procedure since the initial error will be included in the calibration and replicated indefinitely; this is why <u>any</u> calibration MUST be done on near-perfect, flat and level ground.



e.g. A precise dead weight of 100.00T would, at 5° be measured at 99.62T, if during calibration the full scale deflection was then set at 100.00T, <u>all subsequent measurements would be out by 0.</u>4% (unless measured on the same slope). This means that all loads would need an extra 0.4% of material to reach a specified target thus using more stock.

It should be noted that a *mobile* weighing system can **never** be as accurate as a *static* one; load cells in a static weighbridge are purely compression cells and **only** have to support weight, they are not required to be a component of the chassis and be able to withstand bumps and jolts. Also, all the structural steelwork in a weighbridge is securely mounted on a concrete foundation which is, or at least should be, perfectly flat and level.

4) Mechanical Contact between weighing platform and chassis

Inaccuracy can be introduced if there is any mechanical contact between the platform and the chassis and may only occur when FULLY LOADED. This can apparently reduce the weight that should **all** be through the load cells.

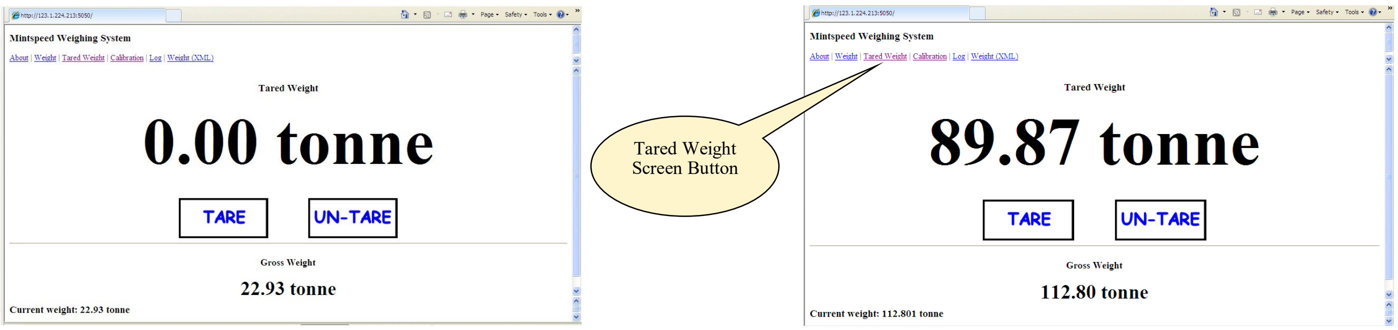
Appendix 3.3 Calibration Notes, Weight Checking

Weight Checking and Calibration
It may be a requirement to carry out regular ***Weight CHECKS*** on each trailer using test weights in conjunction with the web browser software in each trailer but;

DO NOT USE the calibration function to CHECK Weight accuracy; use the Tared Weight screen
This is available from the Utilities home page.

If the calibration procedure is used without having a clear understanding of what's involved there is a risk of introducing significant errors, much larger than those you're attempting to eliminate; some are covered on page 4.

Zero Load **90,000Kg Load**



In the above example, with an empty platform, the ***TARE*** button was pressed with a Gross Weight of 22.93T; a 90T (90,000Kg) test weight was loaded and the weight recorded. This example has a small error of 130Kg; this equates to 0.14% with respect to the net load and 0.11% with respect to the gross load. This trailer **SHOULD NOT** be calibrated; it doesn't need it.

We strongly advise using the PlayStation to experiment with the calibration procedure to gain experience

Test Weights
It is very important to remember that the empty scrap basket uses about a 1/4 or 1/3 of the total capacity of the weighing system, consequently, the ***area of interest*** therefore is in the ***upper*** 3/4 or 2/3; checking and calibration in the lower 1/3 of the system span is actually pointless.

It is therefore counter productive to use a small set of weights that barely ***tickle*** the weighing system. For example, setting zero with no load and then using a single, 10T test weight to set ***span*** at 10,000Kg. This method relies on ***extrapolation*** for weights greater than 10T and is notoriously inaccurate; for a 150 Tonne trailer, this is only **6%** of the rated load and any errors at this level will be significantly ***amplified*** as load is increased (see graph 1 on page 5)

In the same way that the ONLY way to reliable calibrate a temperature measurement system is to boil fresh water at sea level to set the value of 100°C there is no substitute for using accurate, test weights to check and calibrate weighing systems and unfortunately, these need to be **LARGE**. The use of many small weights is fraught with problems, these are;

1. They take a lot of time to load / unload
2. They are potentially dangerous if stacked-up
3. Individual errors on each weight will accumulate and introduce inaccuracies
4. The test weights need to be symmetrically positioned close to the Centre of Gravity of the Scrap Basket and lots of small weights make this difficult to achieve.

Appendix 3.4 Calibration Notes, Basic Principles

Principles of calibration procedures

The ScrapMan weighing computer arithmetically adds the weight readings from the individual load cells; as already described, these are already digitised and scaled in engineering units of Kg at the load cell itself. and this calibration was done in a test laboratory using specialist equipment and to a standard that would be impossible to achive in the scrap yard. The calibrated values within each load cell **cannot** be changed on site, only in a test lab with suitable equipment and software. However, the trailer computer does include some software to to permit the resultant total weight to be tweaked up or down if, with the passage of time, weighing errors are observed. This is accomplished by adjusting the ***Weight GAIN*** factor in one of the text files residing in the C/F card; the file is called ***CalibrationSettings.xml*** and typically looks like…..


```xml
<?xml version="1.0" encoding="utf-8"?>
<Settings>
<Weight>
<Gain>1.0</Gain>
<UseOffset>false</UseOffset>
<Offset>0</Offset>
<!-- Cal weight in lbs -->
<CalWeight>196498 </CalWeight>
</Weight>
<Battery>
<Gain>1.0</Gain>
</Battery>
</Settings>
```


Weight GAIN Value for fine-tuning

Calibration Test Weight; this can be adjusted to suit the Actual Test Weights

Battery GAIN, do not change this value, it is related to the battery voltage measurement. It can be adjusted up or down if the voltage measurement has been found to have drifted.

The **Weight GAIN** shown in **RED** is set by default to be **1.0** This means that if the arithmetical sum of all four load cells is 11,382Kg then the weight transmitted to the host system when requested is also 11,382Kg. With the same weight, if the Gain was changed to 1.1 then the transmitted load would be 12,520Kg (11,382 x 1.1) or conversely, if the Gain was set to 0.9 the transmitted load would be 10,243Kg (11,382 x 0.9). The Gain therefore is simply a number by which the measured weight is multiplied-by. This Weight Gain can be set by editing the CalibrationSettings.xml file or, more usually, using the calibration procedure described in the manual. In essence, this is done by setting ***Zero*** (with no load) and ***Span*** (Full Scale Deflection) with a known dead weight applied **which should be close or equal-to the rated load of the trailer.**

However, this should **only** ever be attempted if the following conditions can be met;

1. The trailer MUST be on firm, flat and level ground
2. The test weights MUST be close to the rated maximum load of the trailer
3. Using losts of small weights is potentially dangerous
4. Suitable lifting gear must be available
5. Test weights need to be loaded symmetrically close to the C of G of the scrap basket

The **CalWeight** figure in **Green** is simply the default test weight value; in this case, 90T (90,000Kg). If you have a test weight of 124,371 Kg this value can be typed into the text file as the default value.

Examples of how errors can be introduced are as follows;

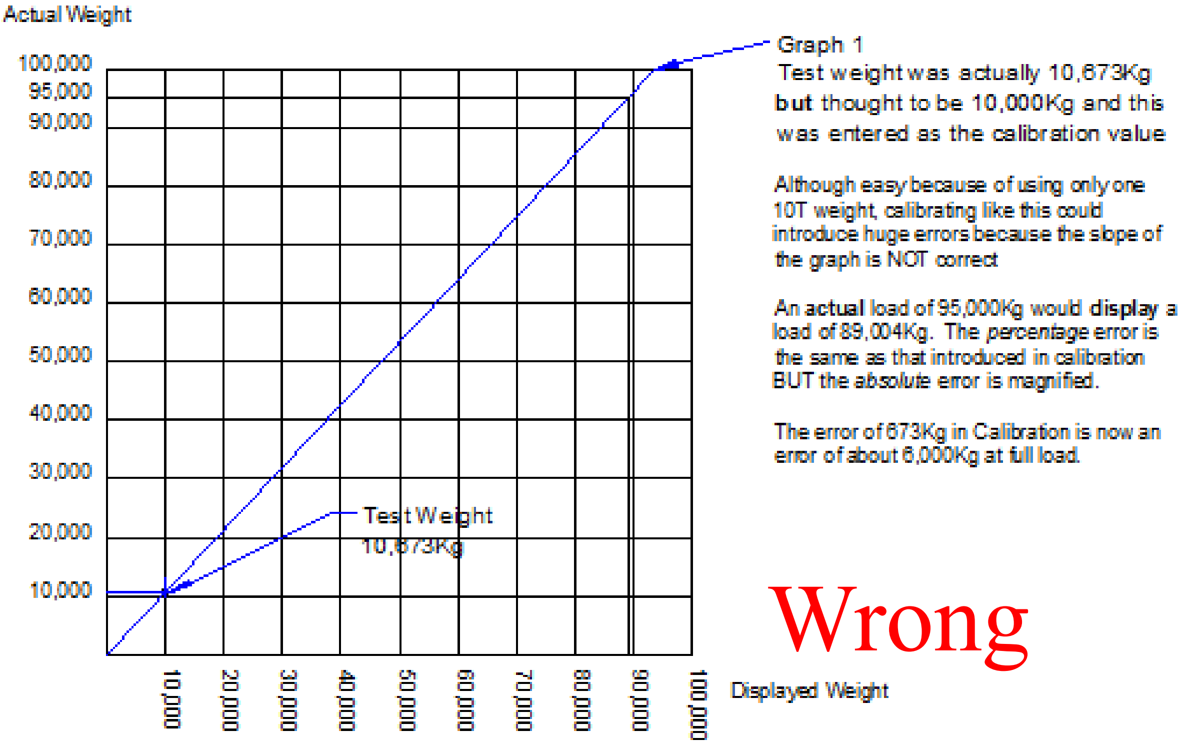
1. If a test weight ***believed*** to be 90,000lbs (but in fact was 90,500lbs) was loaded to the platform and the span set to 90,000 then an inherent error of 500lbs (about 0.5%) has been introduced and the ***weight Gain*** would then be set to 1.005. All subsequent readings would be multiplied by 1.005 and hence be incorrect.

   If this ever happens, the easiest solution is to edit the CalibrationSettings.xml file and set the gain back to 1.0

Appendix 3.5 Calibration Notes, *Interpolation* versus *Extrapolation*

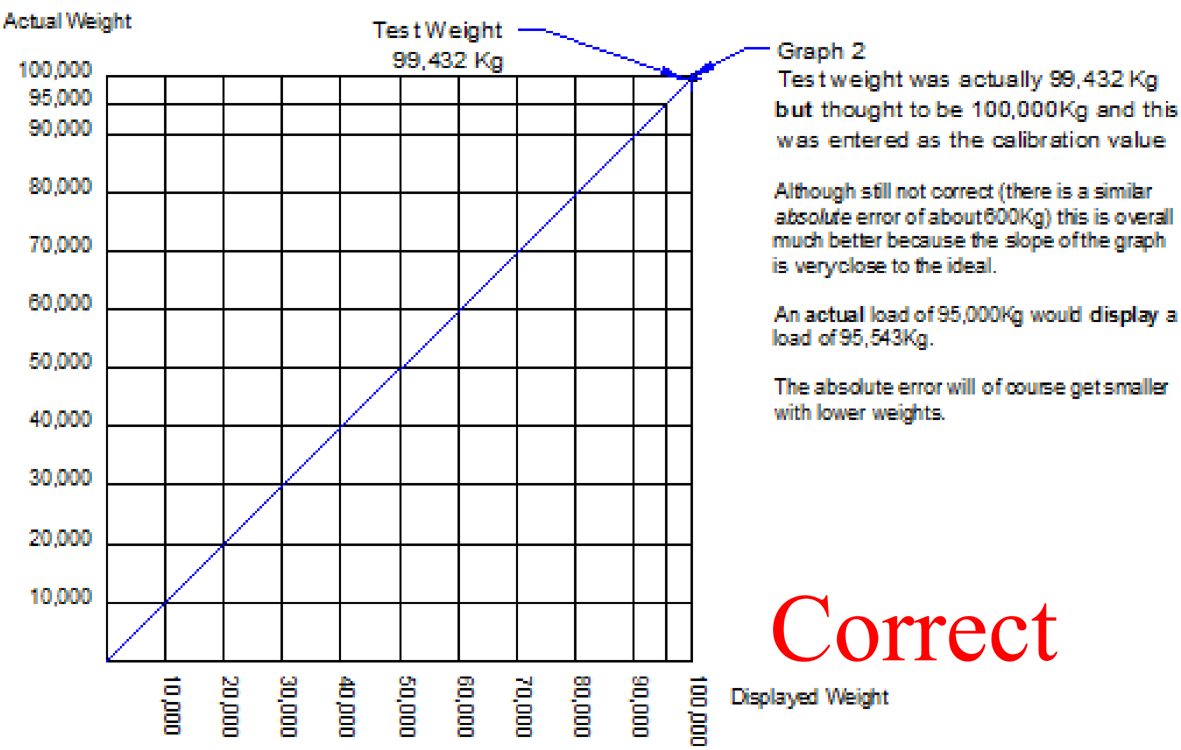
Graphs showing the different effects of the issues surrounding ***Extrapolation*** and ***Interpolation***.
Interpolation using a BIG weight is OK, Extrapolation using a small weight is **NOT OK**

Example 1
Calibrating with a small test weight and *extrapolating* for higher loads



Wrong

Example 2
Calibrating with a large test weight and *interpolating* for lower loads



Correct

Appendix 3.6 Calibration Notes, Editing the "Gain"

Calibration by Statistical Analysis

There is a method of calibration that may be appropriate for some steelworks operations; it would be based on the ***Yield*** from the furnace with comparison to the weight of material ***supplied*** to the furnace and would rely on long-term statistical analysis. As a method of calibration, although not strictly speaking very accurate, it is substantially simpler, quicker and less expensive than loading very large test weights.

This is alluded-to under ***potential sources of error (see below)***

> Another source of problem is the build-up of debris (scrap) on the weighing platform due to ***spillage*** when loading; it must be remembered that if scrap is on the weighing platform **IT WILL BE WEIGHED**. The same is true of scrap that is caught on the scrap basket, it will all be weighed and reported back to the host system. Nevertheless, this scrap **WILL NOT GET LOADED TO THE FURNACE** There is no way the trailer computer or the host computer system can account for this; it requires visual inspection and physical intervention to handle.
>
> Depending on how the external software adds the material weights in the host system this ***apparent loss*** may affect the ***apparent yield***. The shortage is only ***apparent*** since the material hasn't been lost—its still on the trailer or if its fallen off, its still in the scrap yard.
>
> By remote monitoring of the weighing system using the web browser, debris on the platform has been observed to weigh up to 2 or 3 Tonnes. This is deduced by a comparison of ***TARE Weights*** for a particular scrap basket whose empty (TARE) weight seems to ***grow*** each time the empty basket is put back on the trailer. Clearly this doesn't happen but if the platform is cleaned off, the TARE weight of the basket reverts to what it should be.

If over a period of time there was deemed to be an apparent loss of ***material-in*** compared to ***material-out*** (Hot Metal) and this was statistically consistent over time and across all trailers it is reasonable to assume that this discrepancy is due to material being weighed **BUT NOT** loaded to the furnace. As already stated, this is an *apparent* loss in that the material is still in the yard somewhere.

This situation could be handled by changing the ***Weight GAIN*** factor by the amount of the Yield error; for example, if the yield was deemed to be 98% the ***Weight GAIN*** could be changed to 0.98. This would theoretically force an extra 2% of material to be loaded to the scrap basket but since that material is statistically unlikely to get loaded to the furnace anyway, overall it is quite correct.

In the above example, the ***CalibrationSettings.xml*** file would look like…

```
<?xml version="1.0" encoding="utf-8"?>
<Settings>
<Weight>
<Gain>0.98</Gain>
<UseOffset>false</UseOffset>
<Offset>0</Offset>
<!-- Cal weight in Kg -->
<CalWeight>90000</CalWeight>
</Weight>
<Battery>
<Gain>1.0</Gain>
</Battery>
</Settings>
```

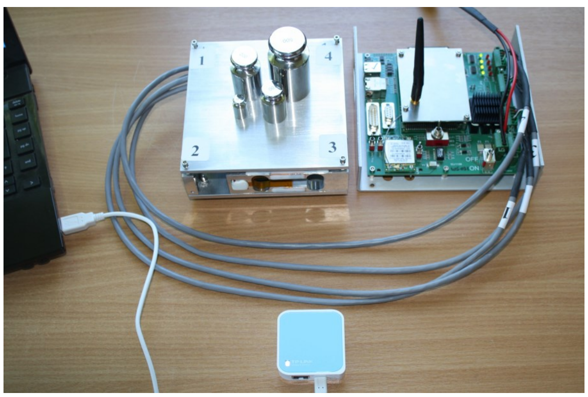
Appendix 3.7 Calibration Notes, Using a PlayStation

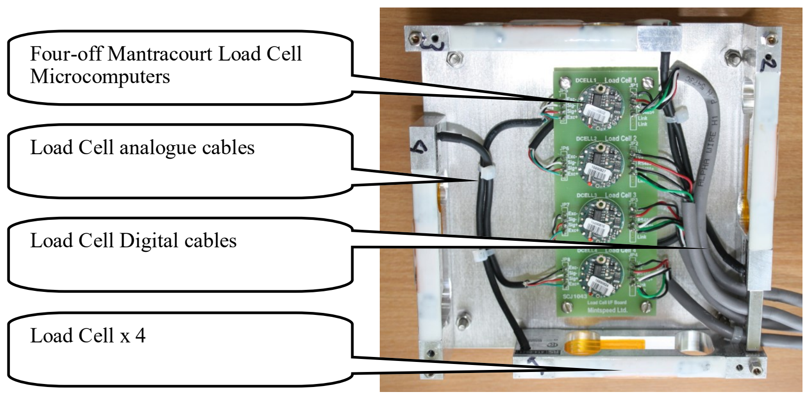
PlayStation Experimentation

It is a good idea to practice and experiment with the calibration procedures using a PlayStation and spare computer but ensure the ***Weight GAIN*** value is set back to **1.0** before using the computer or Compact Flash card in the scrap yard; this is the variable programmed into the ***CalibrationSettings.xml*** file (shown below).

The typical set-up is shown below with PlayStation (weighing platform) set of test weights, spare computer, wireless router and a PC. The weighing platform has four load cells and like the actual trailer, each has a Mantracourt Micro-controller included for the ***digitising*** of the weight measurement. These load cells have been ***artificially scaled*** to measure in Tonnes instead of grams.

Each has a nominal capacity of 300 gram , these were loaded with test weights to 300.00 gram but the microcomputer in each cell was ***scaled*** with test software to *apparently* read 30,000 Kg (30Tonnes) to add some realism to software (100,000:1 scale). This means that with a load on each cell of say 125gm, the load coming back from the load cell microcomputer was 12,500 Kg. This 100,000:1 scaling was set during manufacture and cannot be changed without specialist software.





The PlayStation should be used for experimental purposes and efforts made to deliberately introduce errors such as calibrating on a slope or entering the wrong numeric value of actual test weights. This will allow experience to be gained at spotting problems and the subsequent rectification. After every experimentation session, remove the C/F card and using Notepad, inspect the ***CalibrationSettings.xml*** file and look at the **GAIN**…..

```
<?xml version="1.0" encoding="utf-8"?>
<Settings>
<Weight>
<Gain>1.0</Gain>
<UseOffset>false</UseOffset>
<Offset>0</Offset>
<!-- Cal weight in Kg -->
<CalWeight>90000</CalWeight>
</Weight>
<Battery>
<Gain>1.0</Gain>
</Battery>
</Settings>
```

N.B.
The *Weight GAIN* is the number that ALL reported weights are multiplied by…..
When finished experiments, ensure that the *Weight GAIN* value is RESET to 1.0

A ***successful calibration*** should end up with a ***Weight GAIN*** of ***about* 1**. It should **never** be less than 0.9 or greater than 1.1; either condition would indicate a mistake or a faulty load cell. After calibration, a typical ***CalibrationSettings.xml*** file may look like…..

```
<?xml version="1.0" encoding="utf-8"?>
<Settings>
<Weight>
<Gain>1.00361300682457</Gain>
<UseOffset>false</UseOffset>
<Offset>0</Offset>
<!-- Cal weight in Kg -->
<CalWeight>90000</CalWeight>
</Weight>
<Battery>
<Gain>1.0</Gain>
</Battery>
</Settings>
```

Miscellaneous

Welding

If any welding is necessary to the chassis it is important to observe stringent precautions to prevent damage to the load cells or electronics. The computer should be switched off AND the batteries should be completely disconnected inside the battery compartment. The load cells should be disconnected and the easiest place to do this is at the load cell end as shown in the following photograph.

There will inevitably be a large build-up of lime dust and general mud that may have produced a concretion around the load cell mountings and cable exit. It is important to carefully and thoroughly clean this area BEFORE starting dismantling.

To disconnect the load cell…………..

1) Slide the rubber boot back down the flexible conduit from the load cell connector assembly
2) Grasp the connector locking ring and push inwards, simultaneously twisting anti-clockwise to release the connector. It is a "Bayonet" type locking.
3) Temporarily, put the connector end of the cable in a clean bag of some description to keep it free of dust / mud.

The earth point should be cleared of paint and as close as possible to the area being welded. If the area to be welded is on the weighing platform then the earth clamp should also be on the weighing platform and similarly with the main chassis. If the earth clamp is fixed to the chassis whilst welding the weighing platform the current path will be through the load cell / load cells and they will be seriously damaged.

After welding is complete, reverse the above procedure

Health & Safety Issues

Lead-Acid batteries (Absorbed Glass Mat)

Lead-Acid batteries are a potential hazard and care must be taken in their handling.

Each replaceable battery weighs 30Kg and therefore great care must be taken lifting and lowering these batteries to and from the trailer to prevent spinal or any other physical injury. Similarly, care must be taken when removing or replacing batteries in the rack at the charging facility.

Since batteries contain sulphuric acid, eye protection as well as industrial rubber gloves should be worn at all times during handling. Any acid spillage should be immediately washed with fresh water and medical attention sought.

Great care must be taken to ensure that no metallic or any conducting material comes into simultaneous contact with the +ve and –ve terminals during handling. This will cause a short-circuit and could possibly result in a battery explosion.

It is also extremely important that there should be no smoking or any naked flame permitted in the vicinity of the battery charging area since hydrogen (a very explosive gas) is produced in the charging process.

Load Cell Retaining Pins

The load cells are held in position by three hardened pins. Only two support the load cell (and hence the weight), the centre pin is normally free of any load and is only present to prevent the weighing platform being lifted off the chassis.

There is a degree of permissible lateral movement on these pins within the cradle itself and this movement is limited by large washers and R clips at either end. However, if the basket or trailer structure is involved in a collision, shock loads can be transmitted that can push the hardened pins to the limit of travel and if the impact is sufficient, shear the R clip as shown in this photograph (below).

It is dangerous to leave the trailer in this condition since the large, hardened pins could possibly creep out of the cradle causing the load cell to drop.

It is considered essential that there is a weekly visual inspection of all load cell pins, washers and R clips and especially if a trailer has been involved in a collision.

Cleanliness: It is important to keep the load cells area reasonably clean. Build-up of detritus as shown here can affect accuracy if the deposit hardens (Lime Dust can set like concrete) and limits the deflection of the load cell.

The load cell should be washed once a month with fresh water from a hose and a brush to remove more solid deposits.

A pressure washer should NOT be used because the very high pressures involved (100 bar) could damage seals.