AN OPERATORS GUIDE TO VERSE®

A non-destructive Method of Stress Free Temperature (SFT) Measurement.

UNCONTROLLED DOCUMENT
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1 Introduction

This document provides details of the procedure for selecting a suitable site and making VERSE® SFT measurements.

2 Background

VERSE® (Vertical Rail Stiffness Equipment) is a system developed by Vortok International for measuring the stress free temperature (SFT) of continuous welded rails (CWR). The system is based on the principle that the vertical force required to lift a rail varies with the axial force contained within the rail due to stressing.

Conventional SFT measurement techniques involve cutting the rail. Such destructive measurements are expensive, disruptive and slow. VERSE® fulfils the need for a simple non-destructive SFT measurement technique.

3 System Description
The VERSE® system is supplied complete in its own container.

The main frame is folded into its storage position, and the remaining items of equipment are located in compartments set into the container.

The instrumentation is secured in a separate enclosure within the main container.

The equipment consists of a portable loading frame, which is positioned over the rail to be measured. An upward vertical force is applied to the rail via the system hydraulics. Transducers are used to measure the applied force with respect to the vertical displacement of the rail. This data is stored in a small robust computer, which,
along with a signal conditioning system, powers the transducers, captures their output signals and calculates the SFT to the nearest whole °C (°F). VERSE® SFT results are based on calculating the axial force in the rail from the measured load and displacement data.

The PC requirements to run the Calculation software are:

- Pentium or equivalent PC
- A CD-ROM drive
- A USB port.
- Windows Device Manager, Microsoft Active Sync.
- The PC software installation and operating instructions can be found in Section 8 & 9.
4 Safety Requirements

When using VERSE to measure the rail SFT of continuously welded track, the following points should be observed:

4.1.1 A track possession with the appropriate safety management system is required prior to attempting to make VERSE® measurements.

4.1.2 When the rail is being lifted, always check that everyone is clear before undoing the release valve on the hydraulic jack or releasing the rail jack when inserting or removing the spacer blocks.

4.1.3 On completion of the VERSE® measurement ensure that the track is correctly reinstated and all equipment is removed from site.

4.1.4 Only measure within 30 metres of switch and crossing (S&C) if it is of the strengthened type. On all other occasions you should be outside this distance.

4.1.5 The lifted length of rail, which is 30 metres long (33 metres on heavy rails), should not contain any insulated rail joints (IRJ’s).

4.1.6 The rail within the lifted length should, ideally be of uniform section, i.e. not rails of different sections welded together. If different rail sections are present, the accuracy of the SFT estimate will be degraded.

4.1.7 Ensure any bonded cable connections do not impede the process of lifting the rail.

4.1.8 The ballast adjacent to the rail to be lifted should be at such a level that it does not fall beneath the foot of the rail upon lifting, thus preventing the rail from settling back to its original position once the lift load is removed. If higher than the rail foot, the ballast will need to be scraped away over the lifted length.

4.2 MEASUREMENT CONDITIONS.

4.2.1 Ideally the VERSE® lift should not be carried out when sudden changes in rail temperature are occurring, such as when the sun shines on the rail which has previously been in the shade during a measuring run.

4.2.2 VERSE® measurements are not carried out at rail temperatures above the minimum SFT tolerance, i.e. in the UK this is 21˚C. or if you suspect the rail to be in compression.

4.2.3 VERSE® measurements are not carried out at rail temperatures below - 5˚C in the UK. These values will be different in other climates as declared by the local rail authority.
5 Using VERSE® to Measure SFT

5.1.1 Select the approximate location of the site, and mark the position of any alumino-thermic welds present within the 30m length to be unclipped.

5.1.2 Place three calibrated rail thermometers (or a digital thermometer probe) on the rail web about the lift point, ensuring that these are on the shaded side of the rail and not in direct sunlight. Leave for a minimum of 15 minutes before taking a temperature reading.

5.1.3 Whilst waiting for the temperature sensors to stabilise, mark up approximately 30 metres (33m for CEN60 Rail section or other similar heavy gauge rail sections) to be unclipped (actual distances are dependent on sleeper spacing’s and the 30M is only quoted as a guide). When measuring heavier gauge rails (CEN60 etc), the unclipped length is extended to ensure that during the jacking, that the rail does not cause the first fastened sleeper at each end of the unclipped length to rise out of the ballast.

5.1.4 Mark the approximate 10 metres, either side of the lift point to indicate where the support blocks are to be inserted. Sleeper spacing can vary, and adjustments must be made with the position of each spacer block to ensure they are as evenly spaced as possible.

5.1.5 Unclip the approximate 30m (33m) length of rail.

5.1.6 Jack the rail up and insert the rail support blocks between the rail and the sleepers at the 10m positions. The schematic above shows details of the positioning of the rail support block with relation to the marked position.

5.1.7 Remove any pads or insulators which might be in direct rail contact and effect the result.
5.1.8 Take accurate measurements (to the nearest cm) of each side of the unsupported length of rail and the two outer end spans and record these details. A 1cm error in the measurement of the support block distances will produce a nominal error of 0.1°C in the SFT result. A 1cm error in the measurement of the support end span distances will produce a nominal error of <0.05°C in the SFT result. The distance measured is that between the lift point and the position at which the last fastening restrains the rail.

![Diagram of rail support and measuring points](image)
5.1.9 Care must always be taken when unfolding and folding the lift frame as a scissor action exists. Always ensure that hands and fingers are clear and support the frame as shown in the adjacent photographs. Unlock and unfold the lifting frame, lock the frame in the open position by means of the shot bolt and place the frame over the rail at the lift point.

5.1.10 Place the displacement datum plate (sandbag) firmly in the ballast at the side of the sleeper as shown.
5.1.11 Fit the displacement transducer clamp on to the head of the rail over the datum plate (taking care not to over-tighten the transducer clamp) and adjust the carrier until the transducer is centred and vertical over the datum plate and check that the armature is almost fully depressed. **Note:** Be sure to fold the transducer back into the clamp assembly to protect the unit when not in use as shown below).

5.2 CONNECTIONS.

5.2.1 Connect the force transducer (load cell) and rail clamp assembly to the lift cable via the clevis pin connector.
5.2.2 Fit the rail clamp around the head of the rail and take up the slack in the cable by rotating the adjustable strut or repositioning the cable anchor on the top surface of the cam. When taking up the slack in the lifting cable, always ensure that the cable is correctly located in the recess of the cam operating face.

5.2.3 Connect the displacement transducer, load cell, power supply and Radix cables to the connector box. Note that the connectors are polarised so they can only be fitted into the correct socket.
5.2.4 Determine the rail section by reading the brand marks on the rail web, then measure the rail height to an accuracy of ±0.1mm using an appropriate tool. (The VERSE® equipment contains a vernier calliper with calibrated jaw extension) and record and note the results. A 0.5mm error in the measurement of the rail height will produce a nominal error of <0.3°C (1°F) in the SFT result.
6 The Hand Held Computer/ Data Capture Unit

6.1 RADIX FW900.

6.1.1 The VERSE® system is supplied with a Radix FW900 hand-held computer. This is a small, robust, lightweight, battery-powered PC.

6.1.2 When the Radix is in regular use, keep the batteries on “trickle” charge by placing the unit into the docking station or car charger. When on charge the screen will always illuminate and the red LED will flash. When not in regular use, save the long term battery life by keeping the unit off charge.

6.1.3 The Radix battery should provide power for over six hours of continuous use, (that is to say fully powered up with the screen illuminated). The Radix does not have an ‘On/Off switch. After a 5 minutes has elapsed with no key being pressed, the unit will enter a sleep mode to conserve battery power. To wake the unit from sleep mode, press any key for approximately 5 seconds. The unit will power up and the VERSE program will resume from the same point.

6.1.4 The Radix is supplied with two port protection caps to prevent the ingress of dust and moisture and avoid damage to the communication ports from static discharge. These caps are to be retained in place during normal use and only removed if the communications cable is to be connected to the port or to place the unit in a loader/charger.
6.2 BATTERY OPERATION.

6.2.1 As the battery approaches the point where it cannot sustain normal operation, the Radix will give a two-tone oscillating alarm. It is advised that on hearing this alarm the VERSE measurement is completed and the unit is placed on charge before further operations are commenced.

6.2.2 When normal operation can no longer be sustained a two-tone alarm will activate for five seconds and **BATTERY LOW** will be displayed in the centre of the screen. The display will then become blank and the unit will enter sleep mode. When in this condition it cannot be used. To preserve volatile data such as time/date, the unit must be placed on charge within 24 hours of the two-tone alarm sounding. It will only be possible to wake the handheld when the batteries have reached an adequate level of charge.

6.2.3 If the display is blank press any key for approximately one second. If the Radix does not wake it is probable that the battery is discharged. Place the unit on charge. If the unit does not wake, allow time for it to charge before attempting to use it again.

6.3 CHARGING THE RADIX.

6.3.1 During the charging process, the LED will flash on for half a second and off for half a second, indicating battery charging is in progress. This will continue until the battery is fully charged when the LED will remain continuously illuminated. The time to fully charge the battery will depend on the battery charge state. If the battery is completely flat charging could take in the order of 3 to 5 hours.
6.3.2 The Radix may be used with either a loader/charger or an in car charger. **Note:** Before placing the Radix in the loader/charger remove the dust protection cap from the left-hand communication port (Port B) at the base of the handheld.

![Diagram showing Port B and Port A](image)

**View on base of FW900**

6.3.3 To aid identification the connection face of Port B (left-hand port) is black, the connection face of Port A (right-hand port) is white. Port B is the charging and data transfer port. Port A is the communications port. (for connection to the VERSE control box).

6.3.4 To place the Radix onto the loader/charger, make sure that the Port B dust protection cap is removed and that the handstrap is flat against the handheld and is not twisted.

![Diagram showing handstrap](image)

Pull the slack in the handstrap above the cradle to ensure firm seating and connection.
6.3.5 Insert the Radix vertically into the loader/charger cradle. Position the dust protection cap, removed from Port B, into the recess at the rear of the cradle. Make sure the Port B connector mates with the connector in the base of the cradle.

6.3.6 When the Radix is placed in a loader/charger cradle, the red charge LED at the top of the keyboard should be flashing (when charging) or fully lit (when charged). The LED operates when the handheld is placed into a loader/charger and confirms that a connection has been made. The charging sequence is as follows: Not illuminated - no external power to handheld. Continuous illumination - battery is fully charged and the handheld is ready for use. Slow even flashing - battery is being charged.

6.3.7 Flashing long on, brief off - battery is outside permitted charging temperature range. Move unit to location within permitted range. If the red charge LED does not illuminate check the handheld is correctly seated and that the loader/charger is receiving power.

6.4 COMMUNICATIONS.

6.4.1 The Radix can communicate with a host PC when placed in the loader/charger or using a cable connection through Port A or Port B. These options make the transfer of data between the handheld and the host computer easy and reliable and can be summarized as follows: The loader/charger provides Ethernet and USB Client and USB Host connectivity. The Radix Port A has full RS232 functionality. Port B provides USB Client and USB Host and Ethernet functionality. Microsoft® ActiveSync allows data transfer between Port B and a host computer through a USB link, in either of the following ways: With the Radix placed in the loader/charger. This is the recommended method, as this will also keep the handheld batteries charged. Or directly from the host computer to the Radix Port B using a cable connection.

6.4.2 If the host PC is using Windows Vista as its operating system, Active Sync is not available for communicating with the Radix. In this case Windows Mobile Device Centre (WMDC) should be used. Copies of both Active Sync and WMDC are available on the CD issued with the equipment.
6.5 SLEEP MODE.

6.5.1 When using the 48 - key keyboard, the Radix does not have an ‘On/Off’ switch. After a specified time (5 mins) has elapsed with no key being pressed the unit will enter a sleep mode to conserve power.

6.5.2 To wake the Radix from sleep mode, press any key for approximately 5 seconds. The unit will wake up and the VERSE program will resume from the same point.

6.6 RESETTING THE RADIX FW900.

6.6.1 It is sometimes possible, because of the Windows CE environment that the development of the VERSE application program may become unstable and hang. In order to restore operation from this condition, reset the unit by carrying out a “three-key” reset. Pressing and holding either of the following sets of keys for at least four seconds achieve this.
6.7 THE 48 KEY KEYBOARD.

6.7.1 The function of the keyboard keys is as follows:

Alt and Shift.

These shift function keys work in a similar manner to the corresponding keys of a PC.
6.7.2 The Radix Super Shift key provides access to a set of additional symbols and functions printed above each letter key on the keyboard.

Radix Super Shift.

6.7.3 The Control Pad includes a four directional cursor movement key that may be used to move the cursor between selected fields, or move the text insertion point.

Cursor Control.

6.7.4 The Enter key functions in a similar manner to the Enter or Return key on a PC.

Enter key.

6.7.5 The number keys function in a similar manner to the block of number keys on a PC.

Number Keys.
6.7.6 The letter keys function in a similar way to the corresponding keys on a PC. The default condition of the letter keys is to provide lower-case letters as you type. Press the shift key before you type a letter to provide a single upper-case letter.

6.7.7 Press the Radix key and the shift key to toggle the caps lock function on and off

6.7.8 Note.
When using the keypad to insert data into the Radix, holding down the pressing the P key will insert the decimal point. (in this mode there is no need to select the subtext).

When rail temperatures are below zero, a minus sign may be entered by pressing the Radix key in conjunction with the I key (sub text -).
7 Setting up the Instrumentation

7.1 MAIN COMPONENTS

The control box is a self-contained data acquisition system with its own internal power supply, which also provides power for the VERSE® force and displacement transducers. The force and displacement transducers connect directly via dedicated cables. Additional connections provide a means to connect the Radix, and a battery charger for the internal power supply.

7.1.1 Check all the equipment is present. The operator should have the Radix computer, the data cable, the control box, the displacement transducer, and the force transducer.

7.1.2 Connect the force transducer and the displacement transducer to the control box.

7.1.3 Connect the data cable to the Radix and to the control box.

7.1.4 Set up the VERSE® frame as described in Section 5.

7.1.5 Set up the force transducer and the displacement transducer as described in Section 5.

7.1.6 Wake up the Radix by pressing any key for approximately 5 seconds.
7.2 INDICATOR LAMPS.

The control box contains a number of LED indicators.
8 Using the Radix to VERSE a rail.

8.1 WAKE UP.

8.1.1 Wake up the Radix from sleep mode by pressing any key for approximately 5 seconds. The VERSE program may still be active from a previous operation and could open in any window. To start afresh, reset the program by using the 3 buttons reset as described in the previous chapter. Or exit menus back to the Main Menu and select Restart VERSE.

8.1.2 The Radix will reboot and open up automatically into the VERSE program, the VERSE title window will display. Press enter to advance to the Language Window.

8.2 LANGUAGE

8.2.1 Choose the operating language by selecting from the pull down menu.

8.2.2 The Radix has a demonstration mode which will allow the program to simulate a VERSE measurement for demonstration purposes. The Demo Mode check box is shown below the language option. If the check box is selected, the Radix will operate independently from the instrumentation and will give a simulated result.

8.2.3 Note: In order to prevent false data being collected, ensure that Demo Mode is deselected before carrying out a true VERSE measurement.
9 Main Menu

9.1.1 The Main Menu has 8 items, which can be chosen using the Tab key, and selected using the Enter key.

a. Measurement Menu is to start the VERSE measurement.

b. History is to review previous results.

c. System Information is to access the licence holder’s details.

d. Battery Level monitors power.

e. System Settings allows adjustments to be made to the program via a password.

f. Suspend will place the Radix in sleep mode.

g. Return to first screen.

h. Restart VERSE.

9.2 MEASUREMENT MENU

9.2.1 To carry out a VERSE measurement, enter the Measurement Menu. Initially the only options available is to Enter Site Details, add Notes or to Exit Menu. Choose to enter the details of the site using the Tab key, and select it using the Enter key.
9.3 HISTORY

9.3.1 Selecting History will allow all the previous results which have been created and are stored in the Radix memory to be viewed. This feature can be particularly useful when carrying out a number of measurements in any shift, where previous results may be checked in order to identify any possible trends.

<table>
<thead>
<tr>
<th>Run</th>
<th>SFT</th>
<th>Error</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-000.0</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>23.1</td>
<td>0</td>
<td>75</td>
</tr>
<tr>
<td>3</td>
<td>23.1</td>
<td>0</td>
<td>75</td>
</tr>
<tr>
<td>4</td>
<td>23.3</td>
<td>0</td>
<td>76</td>
</tr>
</tbody>
</table>

9.4 SYSTEM INFORMATION

9.4.1 System information identifies who the software is registered to. It also lists the serial number of the Radix. The number is a unique identifier to which the software is directly linked.
9.5 BATTERY LEVEL

9.5.1 The Battery Level indicator demonstrates the remaining battery life, both with a slide bar and a % value.

9.6 SYSTEM SETTINGS

9.6.1 The System Settings window is designed so that changes to the Radix setup may be made without the need to connect the unit to a PC.

Access to those setting can be achieved with the insertion of the correct password.
10 Site Detail Editor

The details entered onto the Site Detail Editor are to provide information relating to the location of the VERSE measurement. These boxes will be specific to each individual user, and the box titles can be customised and set in the software menu file according to the users choice.

The boxes identify the route of the track, its number, the distance from the terminus, in either miles/yards or Km/m, and the actual location of the measurement. None of these inputs are used in the VERSE calculation of the SFT. They are however recorded into the data file generated by the VERSE measurement. Enter the details using the keyboard, and move onto the next box by pressing the Tab key.

10.1.1 Work down through all of the boxes in this way, and if satisfied that the inputs are correct, Tab to the Save button and select using the Enter button. Any input errors may be corrected by Tabbing to the Cancel button and selecting using the Enter button. This action will revert the screen back to the Measurement Menu.

10.1.2 Enter Site Details may then be reselected and the screen worked through in the same way, where any errors may be corrected. Upon saving the editor, the screen will revert back to the Measurement Menu, where the Enter Rail Details key will be functional.
11 Rail Info Editor

11.1.1 Choose to Enter Rail Details by using the Tab key, and select it using the Enter key. The rail information editor widow will open as shown.

11.1.2 The details entered into the Rail Info Editor are to record information relating to the actual rail being measured. The Rail box is a pull down list. Scroll down through the list using the arrow keys and move on to the next box using the Tab key. The Section box allows a choice of rail sections. Span Inner 1 is the measurement on one side, from the point of the VERSE rail lift, to the spacer block upon which the rail is suspended, and Span Total 1 is the measurement on that same side from the VERSE rail lift point to the first location where the rail is clipped. Span Inner 2 and Span Total 2 are similar dimensions, which relate to the other side of the VERSE lift point. Enter the details of these measurement into each box using the key pad, and scroll through each using the Tab key. Rail Height is entered in the same way. Work down through all of the boxes, and if satisfied that the inputs are correct, Tab to the Save button and select using the Enter button. Any input errors may be corrected by Tabbing to the Cancel button and selecting using the Enter button. This action will revert the screen back to the Measurement Menu. Enter Rail Details may then be reselected and the screen worked through in the same way, where any errors may be corrected. Upon saving the editor, the screen will revert back to the Measurement Menu, where the Curve Compensation key will be functional.
12 Curve compensation

12.1.1 If zero curve has been previously selected in the Site Detail Editor, do not use the Curve Compensation feature. If however a radius of curve has been included, the user may use the **Curve Compensation** to improve the accuracy of the VERSE measurement.

12.1.2 To include curve compensation in the calculation, check the **Use Curve Compensation** box. Versine measurements must then be taken across the 20m span from one spacer block to the other. Measurements are taken when the rail is clipped and before jacking. This is the clipped Versine. And after it has been lifted onto the spacer blocks, having relaxed into the curve. This is the unclipped Versine. The values must then be inserted into the boxes and the save key selected. See paragraph 12.
12.1.3 The software will then calculate the radius of the curve and ask if the value is to be accepted. If **Yes** is chosen, the calculated radius of curve will be back written over the original curvature inserted in the Site Detail Editor. The curve compensation process will determine how much rail tension has been lost during the measurement process. The calculated relaxation of the rail in the curve will then be added to the calculated SFT and this will be used to improve the accuracy of the final result.
13 Measurement information

13.1.1 Select **View Measurement Information** to check that the data relating to the VERSE measurement has been entered correctly.

A window will show a graphical representation of the measurement site. Use this window to check that all the data has been entered correctly.
14 Measurement Run

14.1.1 Select **Do Measurement Run** to begin the process of measurement.

14.1.2 Prior to carrying out the initial lift of the rail, the user will be asked to input the rail temperatures. If some of the rail is bathed in sunlight, and the remainder in the shade, “Temp Varies” must be selected and temperatures must be taken from 3 locations along the unclipped length and entered into the 3 boxes provided.

14.1.3 At night or in overcast weather, there is only a need to enter one temperature value into the top box. Leave the “Temp Varies” box unchecked. The temperature values will be inserted into the other boxes automatically.
14.1.4 A warning screen will open. Select OK to proceed, Abort to cancel.

14.2 RUN CONTROL

14.2.1 Load and Displacement will be displayed on the Run Control Window, both values will rise as the rail is lifted. An active graph will be displayed during the lift, as the data is collected. At any time during the process a Part Lift option is available. Selection of the part lift key will stop the data collection. As long as over 30 data points have been collected this data will be included into the final calculation.
14.2.2 The software requires 30 data points to achieve a result. Less than 30 data points will display an error message.

14.2.3 Upon completion of the first run, (when the load reaches 10 kN), the VERSE run window will display a full graph with 3 options. **Start New Run**, will allow the computer to measure the next lift. A minimum of 3 lifts should always be taken when measuring the SFT in rail. **Save Data and Exit**, will display the run data. **Edit Notes**, will give access to the notes page so as additional lift detail may be recorded. The graph can be used to evaluate the quality of the measurement. Ideally it should be a straight line with few uneven gaps and no peaks or troughs.
14.2.4 The measurement run may be aborted at any time during the lift by selecting the abort key. If the lift is aborted, the data for the run will be lost.

14.2.5 **Save Data and Exit**, will open up the End Temperature window. Here the user is required to enter the temperature of the rail at the end of the measurement. This allows the software to consider variations in temperature before and after the lifts. The same criteria should be adopted as when entering the start temperatures.

### 14.3 DELAY START OF RUN

14.3.1 Sometimes, when a rail is in a suspended condition, it can still be in contact with a fastening or housing. This can occur when measuring in a curve. The rail tension causes the rail to cord in; the rail sags, and makes contact with a housing or a screw spike.

14.3.2 If the rail is in contact with an object before the lift, it is not be freely suspended, some of its mass is supported at the contact point, this causes and error in the calculation. It is essential for the rail to be freely suspended at the commencement of the lift to make an accurate VERSE measurement. The load cell must start measuring the force from a zero condition.
14.3.3 In some fastening systems it is possible to overcome this problem by moving the fastening or housing away from the contact point. When possible this should be carried out, and the problems overcome.

14.3.4 However on some systems, such as Pandrol e clip, this is not possible as the shoulders are fixed directly into the sleeper and cannot be moved. In this situation the software has a function which will allow the condition to be overcome. **Delayed Start of Run.**

14.3.5 At the commencement of the measurement run, the warning window is displayed. In the warning window there is a tick box entitled “Delay start of run”. Checking the delay start of run box will set the software to enable the rail to be lifted clear of any obstruction. Once clear of the obstruction the measurement can begin.

14.4 RESULTS

14.4.1 Saving the end temperatures will open the result window. The calculated SFT will be displayed for the first run.

14.4.2 Selecting the next key will move through the windows for each lift taken during the measurement. Select OK to save all data and calculate final result.
14.4.3 The data from all of the lifts will be saved to a permanent data file. Saving data will be displayed.

14.4.4 The result will be displayed in the “Average SFT” window. In this example, the Lift Status demonstrates that 3 lifts were taken. All 3 were ok and used in the calculation. A curve Compensation Factor of 4.6 °C was incorporated. The resultant SFT before the curve compensation was 25.0°C, and that the compensated resultant SFT was 29.6°C. Click ok to exit.

14.5 NOTES

14.5.1 At any stage through the measurement process the Notes key may be selected which will open up a notes window.
14.5.2 The Notes window is used to record extra detail relating to the measurement and to the site. This information will be saved into the data file and may be viewed at a later stage on the PC software.

15 Radix - PC Communications

15.1 ACTIVE SYNC / WINDOWS MOBILE DEVICE CENTRE

15.1.1 Communication between the Radix and the PC is carried out using the Loader/Charger and the communications program Active Sync or Mobile Device Centre in Windows Vista.

15.1.2 The Loader/Charger must be connected to the USB connector on the PC using the cable provided.

15.1.3 To access the VERSE data files, and to transfer files into the PC, the Radix must be inserted into the Loader/Charge. Upon location, the PC will immediately identify the Radix, and connect to it. Active Sync or WMDC will open as a window.
15.1.4 When communication is confirmed, the word **Connected** will be displayed in the Guest window. Select **explore** to view the Radix directory tree.

15.2 **RADIX FILE DIRECTORY**

15.2.1 To navigate to the Data directory, select **Disc on Chip**.

15.2.2 Then select **VERSE**.
15.2.3 Then select **DATA**. The VERSE measurement data files are held in this directory.

15.2.4 Each of the data files recorded from the VERSE measurements are held in the Data directory. The files are recorded in numerical order and will remain on the Radix until they are deleted. In order to read a Data file in the VERSE PC software, it must be copied out from the Radix and onto the PC. This can be achieved by using one of two methods. The file may be selected, copied and pasted into the PC, or it may be dragged and dropped onto the PC desktop. When the files are transferred onto the PC they may then be stored into an appropriate VERSE data directory.
16 Data Analysis

16.1 THE PC VERSE® ANALYSIS PROGRAM

Insert the CD-ROM VERSE® into the CD drive on the PC the VERSE® software will install itself. If it does not self-start, select “Start” and type install from the ‘Run’ dialogue box. Follow the instructions on the screen to complete the installation. The software will install a thermometer shortcut onto the desktop. Double-click the mouse cursor on the shortcut to start the VERSE® PC software. You will initially see the introduction page.
16.1.1 The next screen viewed is the main working screen.

16.2 THE PROCESSING OF DATA FILES

16.2.1 Click on the “Open Data File” icon in the task bar.

16.2.2 Clicking on File and clicking on Open using Alt-F followed by Alt-O, or by using Ctrl-O can also access the data file. This opens the dialogue box below. (Note: This pattern of operation is used throughout the program. Using the Alt key and the underlined letter will invoke the command).
16.2.3 Select the required file (such as DEV39.BIN in the example below) and click open. Double clicking on a file will activate the same function. Multiple files can be selected if required. The following window will appear for each file opened. Each window can be minimised using standard windows practice.

16.2.4 The **Lift Details** are shown in a box, and the lower panel gives the details of the BIN file, the time and data of the measurement, the serial number of the Radix, the number of lifts recorded and the run number. If the GPS module is attached Lat and Long will be displayed.
16.2.5 The upper left display is a bar graph of the load/displacement. Each of the green lines represents the acquisition of data taken during the lifting process. The Load is displayed on the vertical axis. The max Load and Displacement for the lift are displayed below the bar graph.

16.2.6 To scroll through the readings taken in one full measurement use the arrow keys in the Select Readings box. If a lift is to be excluded from the calculations remove the “tick” from the Include SFT box by clicking on it.

16.2.7 The average of the results calculated by the handheld computer is shown in the upper window. The colour of the thermometer icon indicates if the result is in tolerance. (Note: Setting the tolerances and colours is detailed in paragraph 5.3.3). The lower window displays the average of the results calculated by the PC. The user has the option to recalculate the result from the handheld automatically upon opening the file by checking the box in the tools options menu.

16.2.8 The Site Details entered into the Radix for the measurement run are shown in this area of the window and can be checked for accuracy.
16.2.9 The **SFT Valid Distance** can be inserted into the area shown for recording on the database. The valid distance is that which is considered by the engineer to be consistent with the SFT result. Pull down options also give the user choices with regard to **Buckle Risk** and **Risk Action**.

16.2.10 **Rail Details** entered into the Radix for the measurement run are shown in this area of the window and can be checked for accuracy. Any notes, which may have been recorded on the Radix at site, will be displayed in the **Notes** window.

16.2.11 If errors in the input data are noted, they can be corrected by unlocking the data file with the **Unlock** button at the bottom of the window.
16.2.12 The details in the each box can now be edited. Those boxes with the colour changed to red, will affect resultant SFT if modified. The “Recalculate” button must be selected if one or more of the red boxes are altered. The file modified will then be displayed in the File Details area as User Altered.

16.2.13 This provides a full auditable trail of modifications and corrections. The original files cannot be modified and the recalculate file cannot be saved. Modified files can however be exported to the database for future reference.

16.2.14 Once the operator is satisfied with the details the file can be saved to the database by clicking “Save to DB” button. Repeat this for each new file (measurement).

16.3 SETTING THE TEMPERATURE TOLERANCES AND COLOURS.

16.3.1 The thermometer icon in the file window displays a colour dependent on the chosen settings in Colour Options. The purpose of this feature is to assist the operator in the easy identification of sites, which may need urgent attention. If the colour is red it is because the result is much too low, or much too high, it indicates urgent corrective action. If the colour were yellow, it would indicate the result is out of tolerance and corrective action is required but is not urgent. If the colour is green the result is in tolerance.

16.3.2 The operator can select the colours and the temperatures at which the colours should change. This is done in the Colour Options window, which is opened by clicking the Colour Options icon or selecting Tools – Colour Options from the Menu bar.
16.3.3 In the “Min” box, enter the temperature below which any result would require urgent corrective action to the stressing of the rail. In the “A” box, enter the temperature, which is the lower limit of the acceptable tolerance. In the “B” box, enter the temperature, which is the upper limit of the acceptable tolerance. In the “Max” box, enter the temperature above which any result would require urgent corrective action to the stressing of the rail. Clicking on either of the colour boxes opens a colour panel, which allows the choice of colour options according to user requirements. Perhaps, green, yellow and red. Choose to work in Degrees Celsius or Degrees Fahrenheit by clicking the appropriate button in the top right corner of the window. When all the settings have been chosen click the **Apply** button.

16.4 THE DATABASE

16.4.1 The database can be viewed in two modes: the “Simple” form or the “Full” form. To view the Simple database click the **Database** menu and select **Display** (Simple) and the key items for each measurement processed is shown. (Note: if –300 is shown as the result it indicates that there was no result. A zero could be confused with an actual result of 0°C or 0°F)

16.4.2 If a more comprehensive view is required, select **Display Full**. If greater analysis is required, or printing in a defined layout the databases can be exported to a *.csv format.
16.4.3 To export a “Simple” database, select **Database – Export Simple** from the menu. The following window opens. Enter a name for the new file in the File name box and click save. A spreadsheet program can then open the file independently. Note that this exported file will not be updated by processing more data files.

16.5 PRODUCING A MEASUREMENT REPORT.

16.5.1 When a data file has been imported and viewed, a **VERSE Measurement Report** may be produced relating to each VERSE measurement. This certificate is in HTML format and it can be adjusted to the customer’s requirements. Check the box in the Tools Options menu to Open the certificate when created.
16.5.2 To produce the HTML file, click on the Create Certificate button. This will open an HTML page on the PC. A certificate will be produced like that below. This will include all the inputs and values recorded during the measurement. This certificate is a true record of the measurement and it can have a name and signature box for validity and authentication purposes. A contractor may choose to present such a certificate as a record of the work done.

![Certificate Image]

16.5.3

16.6 VERSE CONFIDENCE RATING

The Confidence Rating is a feature which gives the Verse user an indication of the accuracy of the calculated SFT. The user has a choice as to the display of this feature, and the settings can be adjusted in the Tools menu by selecting Options.
The Confidence Rating will be displayed by choosing Options, and checking the “Show confidence ratings” box.

A further option exists, whereby only those ratings over 75% are displayed. This can be set by checking the “Show CR’s over 75%” box.

This rating is given as a percentage and does not give any indication of the actual accuracy of the result, but is designed to warn the user when the measured data is below a certain standard.

*It remains the responsibility of the user to decide whether the SFT calculated is valid.*

### 16.7 FUNCTIONALITY

16.7.1 The CR indicates how much confidence the user can have in the calculated SFT result. It is based on how close the SFT is to the average rail temperature and also on how accurately the points fit a straight line. If a CR of less than 75% is calculated, care must be taken when interpreting the results. The software highlights this condition by displaying the SFT in red. There are some cases when a low CR can still provide a reasonable estimate of the SFT.

16.7.2 The following example shows a perfect fit line, which receives a CR of 100% (shown in example 1 of the supplied example files):
16.7.3 In this example the points are quite scattered but still seem to follow a straight line. This result could be used with discretion.

16.7.4 This example has too much scatter in the points for the result to be dependable. This is indicated in the CR of 26% compared to 68% above.

16.7.5 This example has a good line of fit but a poor CR still results. This is because average rail temp is 5.1°C where the SFT is 5.4°C. When operating close to the SFT the equipment becomes less accurate. Again, this result could be used with discretion.

16.7.6 As mentioned above, the CR is based on how well the points fit a straight line and also how close the average rail temperate is to the calculated SFT. To calculate the SFT the software uses linear regression analysis to calculate a line of best fit. The standard error (SE) of the points to this line is also calculated. A confidence rating is calculated based on the SE where 1 is a perfect fit and 0 is the worst fit. An SE of 0.001 will give a CR rating of 75%. A rating is also calculated on how close the SFT is to the average rail temperature. Above 1.5°C this rating is 1 i.e. no effect on accuracy. Below this value the rating gets worse. The two ratings are then multiplied together and converted to a percentage to give the final rating. The overall CR is the average of all the CR’s of the user-selected runs.
17 Calibration

17.1.1 Each year, on the anniversary of the commissioning of the equipment, the load cell and displacement transducer require calibration, which should be carried out by a NAMAS accredited laboratory.

17.1.2 Electronic system calibration should also be carried out annually. This is carried out by Vortok International. On completion, a new calibration certificate will be issued. Assuming complete serviceability of the equipment, full electronic calibration can be carried out during one working day.

17.1.3 The minimum level of equipment required by Vortok International to carry out a calibration is shown below. They are: the Radix and its Communications Cable, the Control Box, the Load Cell (without the rail hook) and the Potentiometer in its clamp.

17.1.4 Any package of instrumentation returned to Vortok International for calibration should contain contact information with names and contact telephone numbers in case of unserviceabilities and for organisation of the return shipment.
18 Measurement it tight curves

18.1.1 It is universally recognised, that as the radius of a track curve reduces, the accuracy of the VERSE® measuring technique is affected. The following procedure is applied in the Radix when taking measurements in tight curves to compensate for the error in the resultant SFT.

18.1.2 When a curved rail is below its neutral temperature and is released from its fasteners, the tension in the rail pulls it towards the centre of the curve. This process reduces the length of the rail as it cords across the curve and so reduces the tension in it, which reduces its effective neutral temperature. The V4 software has the ability to compensate for this change; the simple table below can be used to guide the operator on how that compensation is applied to the result measured by VERSE® to achieve an accurate measurement under these conditions.

18.1.3 Before the rail is removed from its fastenings, a cording line is stretched from one rail spacer block position to the other. The distance of the centre of the curve (the point at which the VERSE® measurement is to be taken) to the cording line is measured in millimetres – this is known as the versine.

18.1.4 The rail is then released from its fasteners, lifted onto its spacer blocks and the versine is measured again these two measurements are extrapolated into the table below to calculate the temperature error to be added to the VERSE® measurement.

18.1.5 When applying the compensation to a VERSE measurement the operator may enter the Versine's into the curve compensation window on the Radix, or carry out the calculation afterwards using the table below.

---

Plan view of curved rail
# SFT Correction Table for tight radius curves between 750m and 300m radius based on 20 meter chord

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<th>Unclipped versine (mm)</th>
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<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
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<th>90</th>
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</tbody>
</table>

**Notes**

This table is based on versines measured on a 20 m chord measured before unclipping the rails (initial versine) and after the verse measurement is made before re clipping (Final versine).

Tabular values are in degrees Centigrade.

If clipped versine is > unclipped versine (green area of chart) then add the value to the measured SFT to give true SFT.

If clipped versine is < unclipped versine (red area of chart) then the rail is in compression at the current temperature.
19 Maintenance Requirements for 
VERSE®

The maintenance of the equipment falls into four categories:

Daily
Weekly
Quarterly
Yearly

The maintenance is of three types:

Mechanical
Electrical
Calibration

The following sections describe the work required for each period with separate descriptions for each item.

Maintenance Regime

19.1 DAILY CHECKS

19.1.1 Electrical

All cables and their connectors
State of charge of Radix battery
State of the power pack batteries.

19.1.2 Mechanical

Lift cable locking screws
Clevis pins
Linear potentiometer
Adjustable jack strut
Hook pivot
Force transducer attachment blocks
19.2 WEEKLY CHECKS

19.2.1 Electrical
As daily checks plus:
Internal battery of Radix

19.2.2 Mechanical
As daily checks plus:
Adjustable jack strut
Feet pivots
Main hinge
Tie bars
All fasteners
Hydraulic leaks on Jack
Sandbag
Clean down

19.3 QUARTERLY CHECKS

19.3.1 Electrical
As monthly checks plus:
Change internal battery on Radix

19.3.2 Mechanical
As monthly checks plus:
Clean and inspect lift cable
Remove and re-grease pivot pins
Check seals
Clean and re-lubricate adjustable jack strut
Magnetic base
Carrying case

19.4 ANNUALLY

19.4.1 Electrical
As quarterly checks plus:
Safety of battery charger unit for the Radix.

19.4.2 Mechanical
As quarterly checks plus:
Full disassembly of equipment, clean and degrease and reassemble
Replace lifting cable and locking bolts

Instructions on how to check items
19.5 ELECTRICAL

19.5.1 Radix/Connector box lead
Check for cuts and damage to the cable
Check cleanliness of connectors and locking ring threads
Check cleanliness of protective caps particularly the threads

19.5.2 Force transducer/Connector box lead
Check for cuts and damage to the cable
Check cleanliness of connectors and locking ring threads

19.5.3 Linear potentiometer lead
Check for cuts and damage to the cable
Check cleanliness of connectors and locking ring threads

19.5.4 Radix/PC lead
Check for cuts and damage to the cable
Check cleanliness of connectors and locking ring threads

19.5.5 Radix internal battery
See manual for Radix

19.6 MECHANICAL

19.6.1 Lift cable
The cable must be inspected for signs of visible damage especially around the crimps. If any strand is broken the cable must be replaced.

19.6.2 Hook
Check there is no physical damage to the hook and that the pivot pin is lightly lubricated and moves freely.
Check the shackle bolt is tight.

19.6.3 Adjustable strut
Remove the assembly and disassemble
Inspect the strut assembly for damage.
Check the condition of the threads and keep lightly lubricated.
Check main body for damage and wear.

19.6.4 Hydraulic Jack
Check for hydraulic leaks, if found replace unit.
19.6.5 Main Hinge
Check seals for damage.
Check Nuts are tightened sufficiently to allow no more than 0.5mm end float of cam.
Ensure free movement of cam and upper strut assembly.
Lubricate lightly with grease.

19.6.6 Feet pivots
Check grease seals, replace if damaged.
Check ends of pivot pins are undamaged.
Check for wear on pivot mechanism. If more than 0.5mm wear replace worn items.
Lubricate lightly with grease.

19.6.7 Carrying case
Check handles for wear and damage
Lubricate hinges, latches and wheel axles with light oil.
20  VERSE Warning, Error Messages and Meanings

Version 4, (See manual for how to use VERSE®)

- Error 410 - Not enough data.
  Not enough data points were collected to calculate an SFT.

- Error 411 - Load too low.
  The load reached was not high enough to calculate an SFT.

- Error 412 - Load out of spec.
  This generally means that the rail is in compression. If the data points do not
  create a straight line to within a certain tolerance then the SFT can not be
  calculated.

- Error 413 - Calc run out.
  This general implies a serious input error as the calculation went through its
  maximum number of iterations.

- Error 414 - Unable to calculate. (Rail temp above SFT ?).
  This error occurs because there are no valid SFT results from which to
  calculate the average SFT value. This can be as a result of the rail
  temperature being above the SFT. If this is the case then it is not possible to
  calculate SFT values.

- Error 415 - Check Hardware.
  The handheld was unable to connect to the transducers. Generally occurs if
  the handheld is not plugged in or the white box is switched off. Also if the cable
  is damaged.

- Error 416 - Version Match Error.
  The software version does not match the menu file version.

- Error 417 - Key not valid.
  The software key file is not valid.
21 Bulleted list of steps required for a successful VERSE® measurement

- Select a measurement site
- Obtain a track possession
- Have received training in the use of VERSE® and hold a certificate of competence.
- Have a complete set VERSE® of equipment, in calibration and ensure the batteries are fully charged.
- Measure accurately and mark up the site as per the manual section 5
- Unclip the selected section of rail, ensuring the rail is not in compression.
- Accurately install the support blocks (± 1cm)
- Set up and record the rail temperature (Section 5.1.2)
- Record the rail type
- Assemble and fit the VERSE® equipment
- Set up and capture the data using the “Radix” data logger
- Check after each lift that the data is valid and accepted by the “Radix”
- Calculate the SFT using the “Radix” data logger. (3 lifts minimum)
- Remove the VERSE® equipment and repack carefully in its container. Ensure that connector box is switched off.
- Depending on the result, reinstate the track or schedule a re-stressing activity.
- Remove all equipment from site and ensure the track is left in a safe condition.
- Relinquish the possession.
- Upload the “Radix” data to a PC and record the results in the database.
- Place the “Radix” on trickle charge and ensure that the equipment is dry and clean ready for next use.