

PLEASE READ BEFORE INSTALLATION

FROM PAST EXPERIENCE OF SUPPLYING SENSITIVE INSTRUMENTATION INTO THE LABORATORIES OF LUBRICANT COMPANIES, WE HAVE FOUND THAT TEST EQUIPMENT SUCH AS DRYING OVENS, STIRRERS, EQUIPMENT WITH LARGE ELECTRICAL MOTORS, OR OTHER APPLIANCES WHICH USE THYRISTOR OR UNSUPPRESSED RELAYS TO CONTROL THEIR MAINS , CAN CAUSE TRANSIENT VOLTAGE SPIKES WHICH CAN ADVERSELY AFFECT OR IN EXTREME CASES DAMAGE COMPUTER EQUIPMENT.

ALTHOUGH BKT INSTRUMENTS ARE ADEQUATELY PROTECTED AND ARE ROBUST ENOUGH FOR THESE ENVIRONMENTS , MAINS SPIKES WHICH WILL PASS THROUGH COMPUTER POWER SUPPLIES CAN IRREPARABLY DAMAGE THE PC30AT COMPUTER CARD SUPPLIED WITH THIS EQUIPMENT.

THEREFORE WE STRONGLY RECOMMEND THE USE OF IN LINE MAINS SUPPRESSION FILTERS ON COMPUTER EQUIPMENT PLAYING HOST TO OUR DATA ACQUISITION CARDS.

FAILURE TO FIT SUCH MAINS PROTECT WILL INVALIDATE ANY WARRANTY OFFERED WITH THE SUPPLY OF THIS SPECIFIC COMPONENT.

■ DESCRIPTIONS AND INFORMATION

All drawings, specifications and particulars of weight and dimensions submitted with BKT's quotations are approximate only and the descriptions and illustrations contained in BKT's catalogues, brochures, price lists and other advertising matter are intended merely to present a general idea of the goods and / or services being provided and none shall form part of any contract with BKT. Furthermore , BKT shall not be liable for the accuracy of any goods and/or services provided, nor for the interpretation of the data acquired or produced by such goods and /or services. Any performance figures given by BKT are based on its experience and are such as BKT would expect to obtain on test at its works. Such figures and data are not guaranteed.

■ BKT's LIMITED HARDWARE WARRANTY

BKT warrants to the Purchaser that the company's hardware is free from defects in workmanship or material under normal use and service. This warranty commences on the date of delivery of the hardware to the Purchaser.

During the warranty period , BKT agrees to repair or replace, at its sole discretion, without charge to the Purchaser, any defective component part of the hardware. To obtain service, Purchaser must return the hardware to BKT or an authorised agent of BKT in an adequate container for shipping. The postage, shipping and insurance charges incurred in shipping to BKT will be paid by Purchaser and all risk for the hardware shall remain with the Purchaser until such time as BKT takes receipt of the hardware. Upon receipt BKT will promptly repair or replace the defective unit, and then return the said unit to Purchaser, postage, shipping and insurance prepaid. In any event BKT's liability for defective hardware is limited to repairing or replacing the hardware.

■ EXCLUSIONS

This warranty is contingent upon proper use of the hardware by Purchaser and does not cover : expendable component parts such as PCI electrodes, PCI Mini-Cells, and DIGI-GALV test probes; or if damage is due to accident, unusual physical, electrical or electromechanical stress, neglect, misuse, failure of electrical power, air conditioning, humidity control, transportation, operation with media not approved by BKT , or by tampering with or altering of the hardware.

■ DURATION

THE WARRANTIES GIVEN HEREIN, TOGETHER WITH ANY IMPLIED WARRANTIES COVERING THE HARDWARE , ARE LIMITED IN DURATION TO THREE MONTHS FROM THE DATE OF DELIVERY TO PURCHASER.

■ LIMITS OF BKT's LIABILITY

BKT SHALL NOT BE LIABLE TO THE PURCHASER FOR LOSS OF DATA, LOSS OF PROFITS, LOST SAVINGS, INCIDENTAL, CONSEQUENTIAL, INDIRECT OR OTHER SIMILAR DAMAGES ARISING FROM BREACH OF WARRANTY, BREACH OF CONTRACT , NEGLIGENCE OR OTHER LEGAL ACTION EVEN IF BKT OR ITS AGENT HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, OR FOR ANY CLAIM BROUGHT ABOUT BY YOU OR BY ANOTHER PARTY.

CONTENTS

1.0	INTRODUCTION	1
2.0	OVERVIEW	2
3.0	INSTALLATION	
3.1	<i>Installing the Hardware</i>	4
3.2	<i>Installing the Software</i>	5
3.3	<i>Mini-Cell Preparation</i>	6
	<i>Electrode (Metal) Specimen Preparation</i>	
3.4	<i>Instrument Status</i>	7
4.0	USING THE INSTRUMENT (A QUICK GUIDE TO RUNNING A TEST)	
4.1	<i>Turning On and Off</i>	8
4.2	<i>Running PciWin</i>	8
5.0	TEST APPLICATIONS	
5.1	<i>Rest Potential</i>	13
5.2	<i>Current-Time</i>	15
5.3	<i>Sweep</i>	16
	<i>Test Variables</i>	
	<i>Normalisation of Sweep Tests</i>	
	<i>Statistics</i>	
	<i>Overlaying</i>	
6.0	PciWin SOFTWARE IN DETAIL	
6.1	<i>The Main Screen</i>	24
6.2	<i>Displaying Tests</i>	25
6.3	<i>Manipulating Tests On-Screen</i>	26
6.4	<i>Viewing Test Window data</i>	27
6.5	<i>Printing the Active Window</i>	27
6.6	<i>Saving Tests to Disc</i>	28
6.7	<i>Changing the Test Name and Date</i>	29
6.8	<i>Positioning X-axis Labels</i>	29
7.0	THE AUTO TEST FEATURE	30
8.0	INTERPRETATION OF SWEEP CURVES	32
8.1	<i>Active Passive Transitions</i>	32
8.2	<i>Surface Films</i>	34
8.3	<i>Aggressive Ions</i>	36
8.4	<i>Dilution Sensitivity</i>	38

1.0 INTRODUCTION

The PCI2002 is a second generation instrument designed for industry use as a tool for the measurement and prediction of inhibitor performance in metalworking, hydraulic water based fluids and lubricants.

The equipment consists of :-

- a) A Mini-Cell test cell
- b) A digitally controlled DUAL RANGE precision electrochemical potentiostat instrument unit.
- c) A desktop P.C , fitted with an A/D , I/O card running C++ WINDOWS compiled executable analysis software (PciWin).

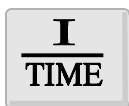
2.0 OVERVIEW

Using PciWin the PCI 2002 instrument can be quickly and easily configured to perform one of three modes of electrochemical testing.



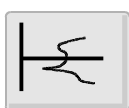
REST POTENTIAL

Used to display the metal/solution interface potential , gives visual evidence of the presence of inhibitors at a metal surface. Can be used to screen inhibitors for selective metals, or show active/passive transitions due to pH changes or aggressive ions.



CURRENT - TIME

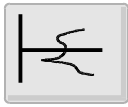
Used to set an overpotential that locks inhibitors on a metal surface, gives visual record of inhibitor 's long term stability. Mainly used for inhibitor persistence tests.



SWEEP

Used to perform one of several potentiodynamic (SWEEP) tests. See "Sweep Style" in PciWin Application Help.

- ☒ Ramp One Way
- ☐ Cycle
- ☐ Centre Cycle
- ☐ Central One Way



SWEEP

Defaults to a Ramp One Way sweep test, gives visual display of the inhibitor filming characteristics of an oil emulsion or synthetic fluid system. Can be used to :-

- a) Compare performance of proprietary fluids.
- b) Compare dilution sensitivity of proprietary products.
- c) Determine concentration of inhibitors required for trouble free performance in varying degrees of water hardness.
- d) Illustrate synergism of inhibitor systems.
- e) Test recycled fluids for correct dosing of depleted additives.
- f) Illustrate competitive ion effects ie effect of thickeners, EP additives, anti-foams on corrosion inhibitor performance.

3.0 INSTALLATION

3.1 *Installing the Hardware*

- a) MAKE SURE THAT THE COMPUTER IS SWITCHED OFF AT THE MAINS, BUT HAS IT'S MAINS LEAD CONNECTED AT THE REAR.
(ie THE CASE IS EARTHED)
- b) (PC30AT Installation)
MAKE SURE THAT YOU TOUCH THE METAL CASING INSIDE THE COMPUTER BEFORE REMOVING THE AMPLICON CARD FROM IT'S STATIC PROTECTION PACKAGING. (THIS EARTHES THE STATIC ON YOU).
- c) SLIDE THE CARD INTO AN EMPTY EXPANSION SLOT.
- d) THE CARD IS SUPPLIED ALREADY CALIBRATED & SET UP FOR THIS APPLICATION.
- e) ** THE ON BOARD WAIT STATE GENERATOR ON THE PC30AT CARD CAN BE VARIED TO SUIT THE I/O BUSS SPEED OF YOUR COMPUTER. **

WE HAVE SET THE CARD (JUMPER J17 TO POSITION 3, CORRESPONDING TO 8-10 MHz ASSUMING YOUR COMPUTER IS A DELL WITH A STANDARD BUSS SPEED SEE P7 PC30AT MANUAL. IF YOU ARE OPERATING A DX2 MACHINE (CLOCK SPEED 66MHz , I/O BUSS SPEED 33 MHz) SELECT POSITION 1
- f) THIS JUMPER J17 IS THE ONLY SETTING ON THE CARD THAT MAY NEED TO BE CHANGED TO OPTIMISE SOFTWARE SPEED.

** PLEASE DO NOT TOUCH ANY OTHER CARD SETTING **
- g) LOCATE THE PCI2002 VER2, 37/50 WAY LEAD TO CONNECT THE INSTRUMENT TO THE COMPUTER.
- h) LOCATE EURO MAINS LEAD INTO CONNECTOR IN THE REAR OF THE INSTRUMENT.
- i) TURN ON THE INSTRUMENT VIA THE SWITCH ON THE EURO-MAINS SOCKET AT THE REAR OF THE
(POWER LED (RED) SHOULD LIGHT)
- j) SWITCH ON COMPUTER AND MONITOR

3.2 *Installing the Software*

To install PciWin for the first time you must first copy the executable files onto the your hardrive , together with three .vbx control files. The "Install.bat" program supplied on the disc is designed to install PciWin from the Windows DOS prompt. The .bat program will create a directory C:\PCIWIN on your hardrive and will automatically copy files into this directory and the windows system directory.

To install this software follow the steps:-

- a) From within windows double click on MS DOS Prompt icon in MAIN, at the C:\WINDOWS prompt type A:\ **install** and press return.
- b) After the batch file has copied the necessary files the message "Installation Complete Type EXIT and press return to close DOS window" should appear.
- c) Type EXIT and return to Windows Program Manager
- d) Select "Windows Setup" icon in MAIN and double click
- e) From "Options" menu select Set up Applications
- f) In Set Up Applications select "Ask to specify an application" Click OK
- g) At the flashing cursor type " C:\PCIWIN\PCIWIN.EXE " click OK and close windows set up box
- h) You should now have an Icon named PciWin in the Applications group box in Windows
- i) Double click this Icon to start PciWin

**** PLEASE NOTE ****

PciWin version 1.5 and above utilises  dongel copy protection.



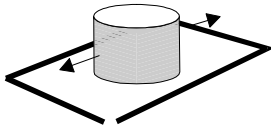
ENSURE THAT THE COMPUTER IS SWITCHED OFF.
Connect the dongel supplied into the parallel printer port
of the DELL computer system unit.
Connect the printer cable into the back of the dongel.

Note :- computer parallel ports can be damaged by connecting and disconnecting dongels
whilst the computer is switched on.

3.3.1 Electrode (Metal) Specimen Preparation



PCI specimens are supplied with one face machine ground to approximately a P400 surface finish. For consistency and reproducibility of test results it is essential that specimen preparation is adhered too. Prepare a specimen by polishing the ground surface wet on progressively finer P800 then P1200 Wet & Dry paper. Inspect surface for pits, and finish the surface by 10-20 forward and backward polishing movements on a 50mm square virgin piece of P1200 Wet & Dry.



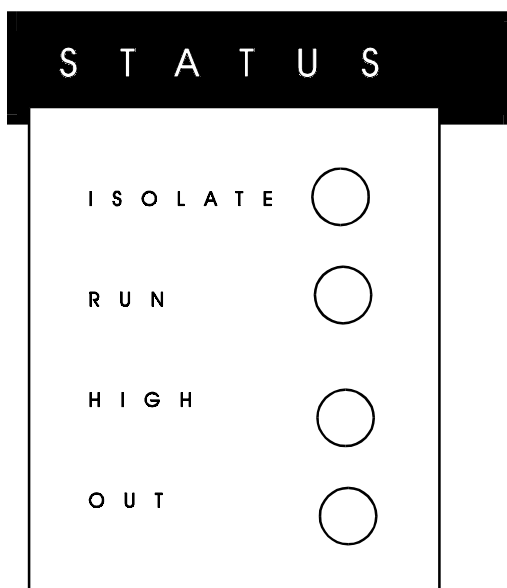
After finishing polishing, rinse the polished face under distilled water, and dry the specimen *leaving the polished face wetted*.

Check the polished face for evidence of micro-pits if it is being reused after a Sweep test.



By leaving the specimen face wet a convex water meniscus which magnifies the surface will show any micro-pits if present. If the specimen surface is pit free assemble the Mini-Cell.

3.4 Instrument Status



No output to Mini-Cell test cell

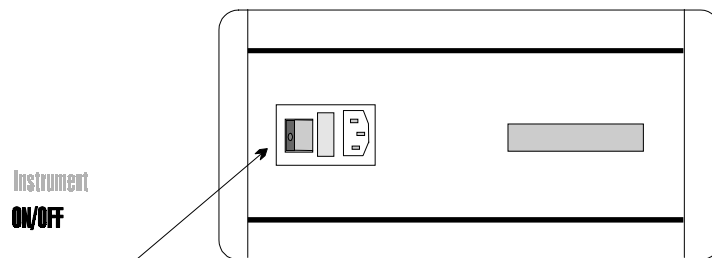
Instrument is switched into HIGH range automatically to measure currents $< 50\mu\text{A}$

Instrument is running a test

Error detection over voltage and/or current
(Usually triggered when insufficient fluid in cell ie no current path between counter and specimen)

4.0 USING THE INSTRUMENT (A *QUICK GUIDE TO RUNNING A TEST*)

4.1 *Turning On and Off*



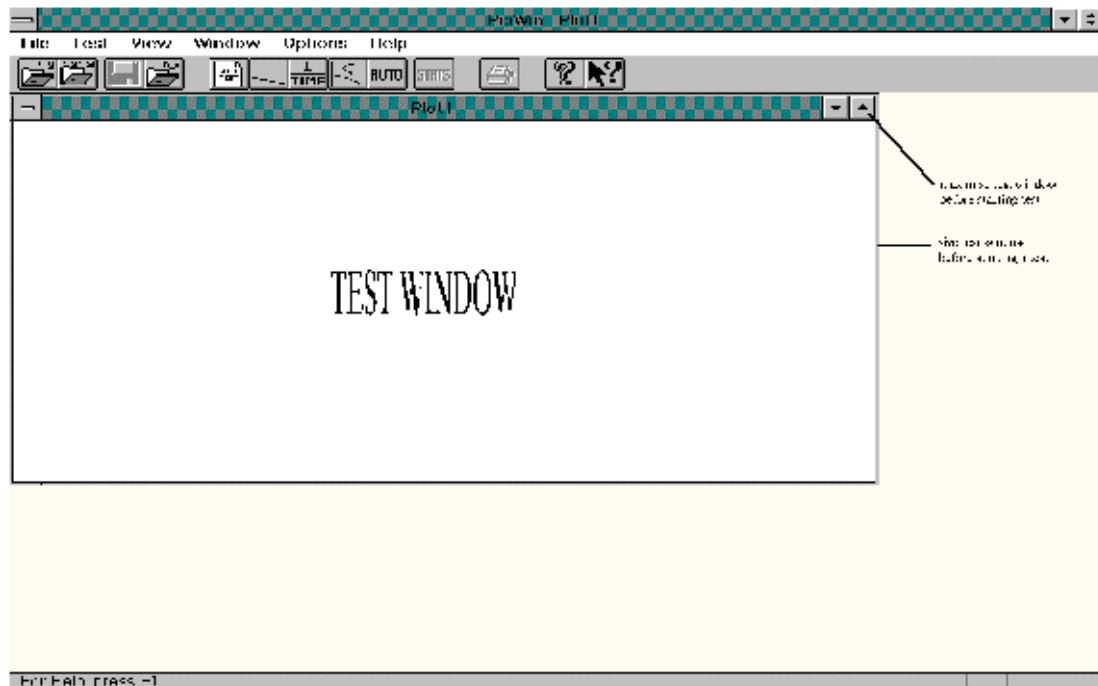
When switching on the PCI System it is recommended good practice to switch **ON** the equipment in the sequence PCI2002 instrument unit first, followed by the Dell System Unit and Monitor.

Turn the instrument **OFF** by reverse sequence ie. instrument unit last.

4.2 *Running Pci Win*



Double click on the PciWin icon in the Applications group box in Windows to open PciWin.

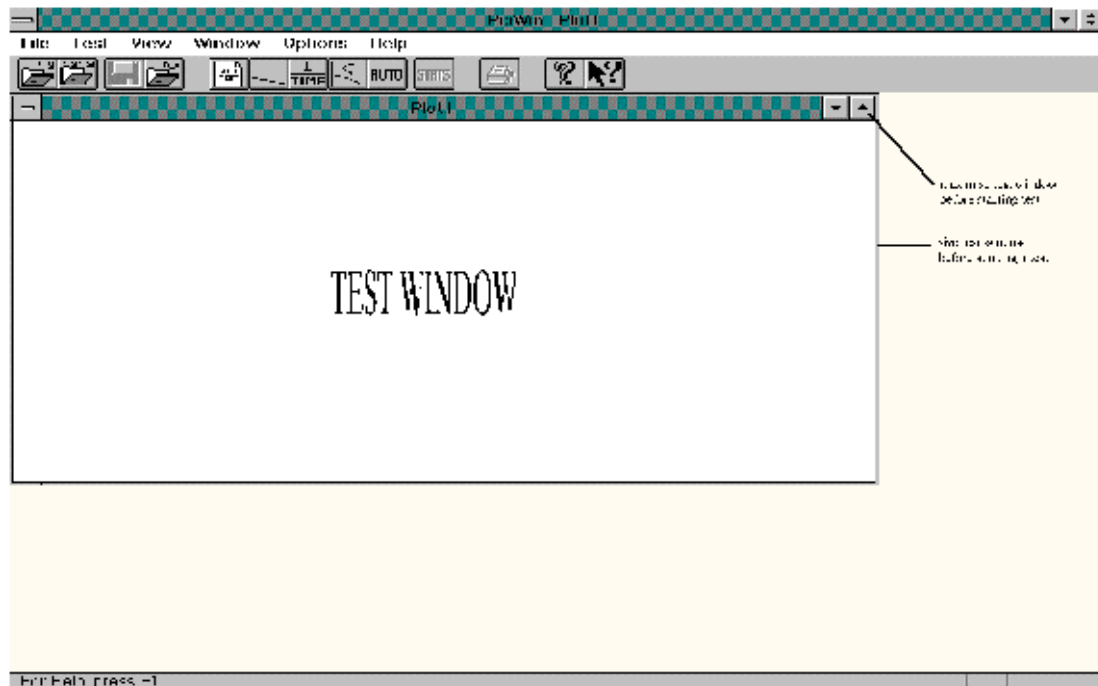


PciWin Opening Screen

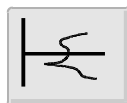
Before you can begin running *any test* in PciWin you first have to open a "Test Window".



Open a "Test Window" by clicking the mouse cursor on the button.

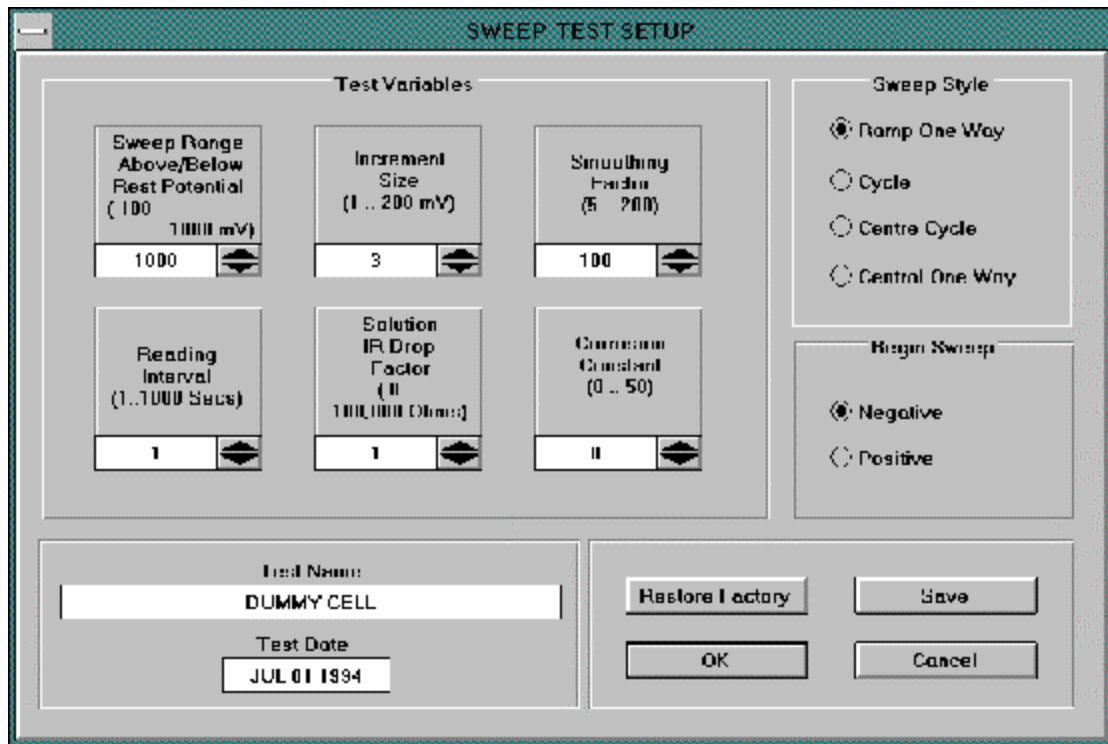


Resize or maximise your Test Window before , clicking one of three possible test buttons that have



now become active . Click on test button to select a Sweep Test. The "Sweep Test Setup" box will appear, with the cursor automatically flashing in the "Test Name" box. Enter the test name "DUMMY CELL" , and then place the DUMMY CELL supplied with the instrument into the connector marked CELL on the front panel of the PCI2002.

The "Sweep Test Setup " box allows the user to configure all the sweep test variable test parameters. The test parameters are factory set to default to a standard Ramp One Way sweep. Application of sweep tests and sweep test variables are discussed in detail in section 5.0 named TEST APPLICATIONS.



SWEEP TEST SETUP

Test Variables

Sweep Range Above/Below Rest Potential (100 .. 10000 mV) 1000	Increment Size (1 .. 200 mV) 3	Smoothing Factor (5 .. 200) 100
Reading Interval (1 .. 1000 Secs) 1	Solution IR Drop Factor (1 .. 10000 Ohms) 1	Currents Constant (0 .. 50) 11

Sweep Style

- ☒ Ramp One Way
- ☐ Cycle
- ☐ Centre Cycle
- ☐ Central One Way

Begin Sweep

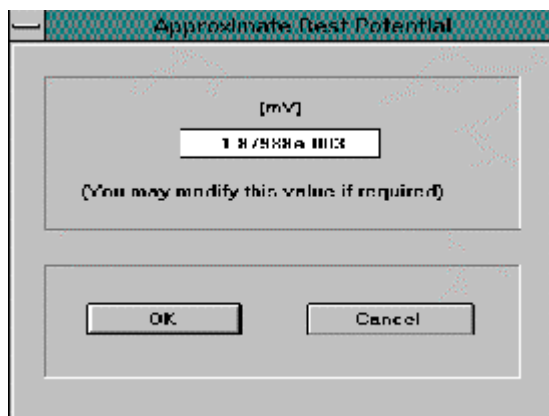
- ☒ Negative
- ☐ Positive

Test Name:
DUMMY CELL

Test Date:
JUL 01 1994

The default factory test parameters can be edited by using the TAB key on the keyboard to jump between input boxes and or by directly placing the cursor over the numbers and clicking the left mouse button to enter the box. These new test parameters can then be saved as "NEW DEFAULTS" by clicking on SAVE .

PRESS Return or click on **OK** to start a DUMMY CELL sweep test. The instrument will switch into ISOLATE status and the screen will display the "Approximate Rest Potential " box.



Approximate Rest Potential

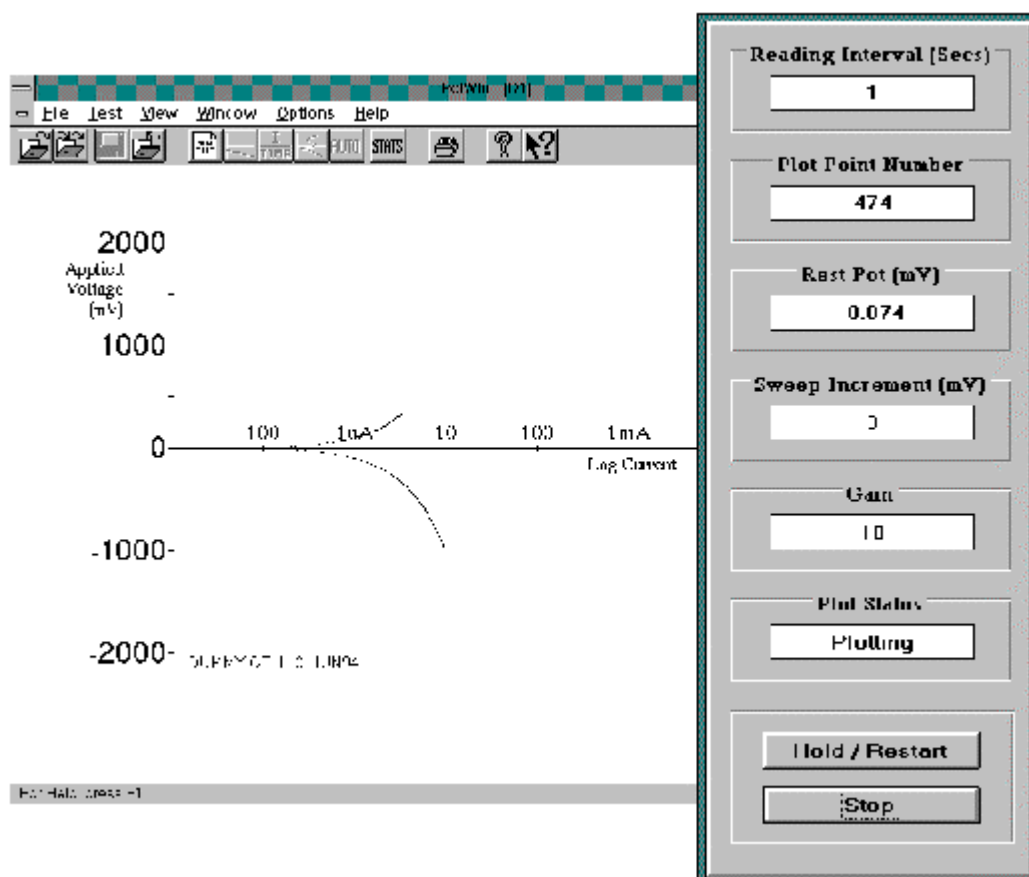
[mV]

18.8888 mV

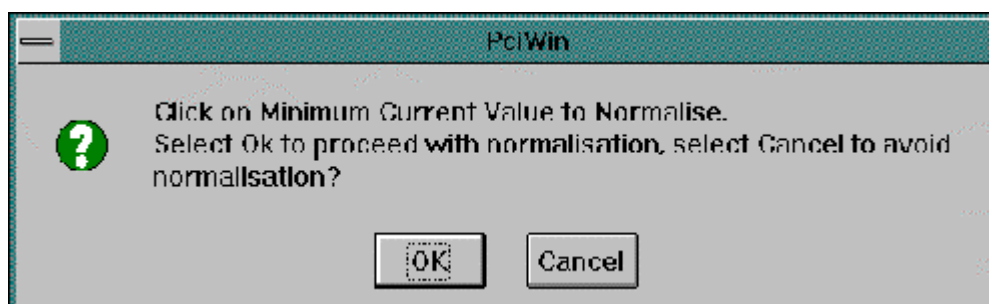
(You may modify this value if required)

The actual value is not critical to a DUMMY CELL test and may vary from instrument to instrument if both DIGI-GALV and PCI 2002 share the same PC30AT card. (ie the card is set to zero the DIGI-GALV opposed to the PCI instrument.)

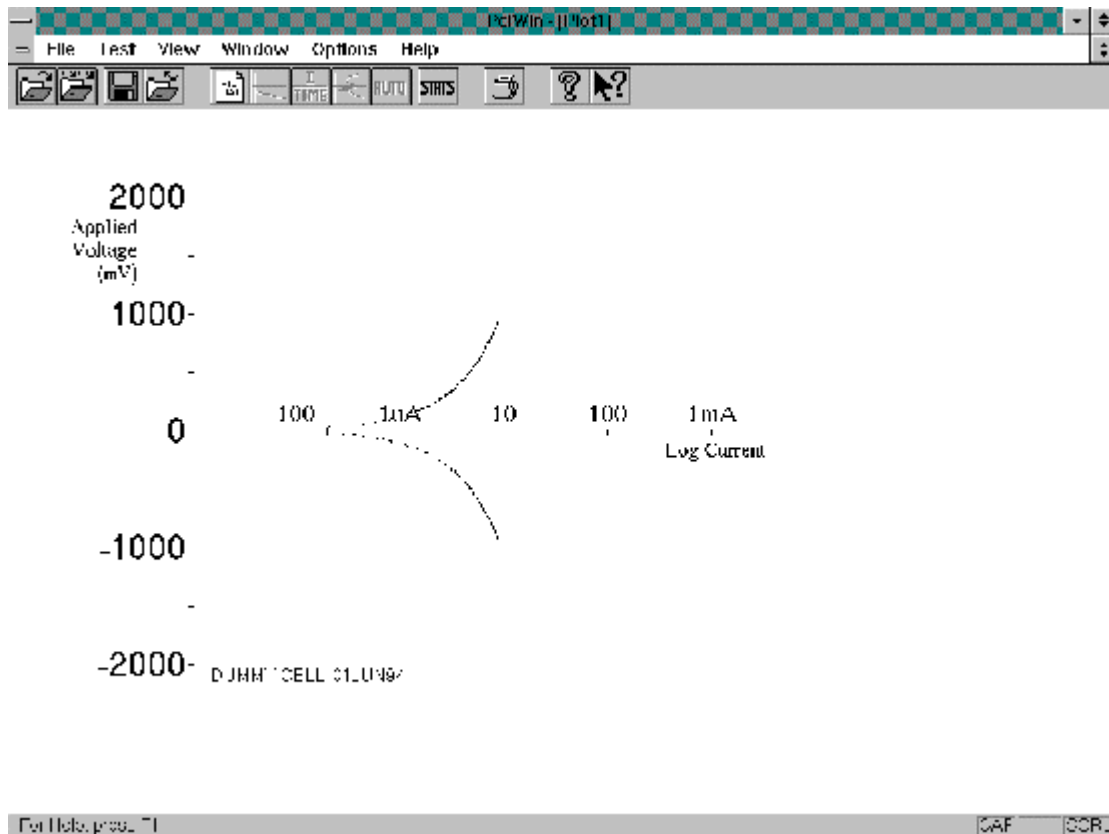
PRESS Return or click on **OK** to initiate the test , the instrument will switch into RUN status and the screen will display the sweep test graph axes together with a new box, the "Run Time Sweep Statistics" (RTSS) box. The RTSS box displays the sweep parameters selected for the test and has two active buttons "HOLD/RESTART" and "STOP". Hold/Restart allows the user to suspend the sweep increment at a specific plot number or overpotential and maintain an Applied Voltage across the cell . The Stop button allows the user to abort a test.



When the sweep range has been completed the Sweep Test automatically displays the box below :-

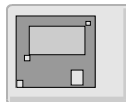


Click on **CANCEL** for the moment (as this is only a DUMMY CELL test) Normalisation of sweep tests is covered later in section 5.0. The box will disappear and the completed DUMMY CELL test will remain in its Test Window.



CONGRATULATIONS

You have just carried out your first test and also checked out your PCI system. Remember that the test is only held in the computer memory, so be sure to save it to disk by either FILE- SAVE , from the



Menu or by clicking on the quick button **CTRL +S**.

5.0 TEST APPLICATIONS



5.1 *Rest Potential*

Rest Potential tests are used to :-

- Screen surface activity of water soluble additives on different metal specimens.
- Show the presence of active/passive surface oxide layers on metals that exhibit dual metal/solution interface potentials.
- Show that the system has reached an equilibrium inhibited solution/interface potential prior to initiating a sweep test.

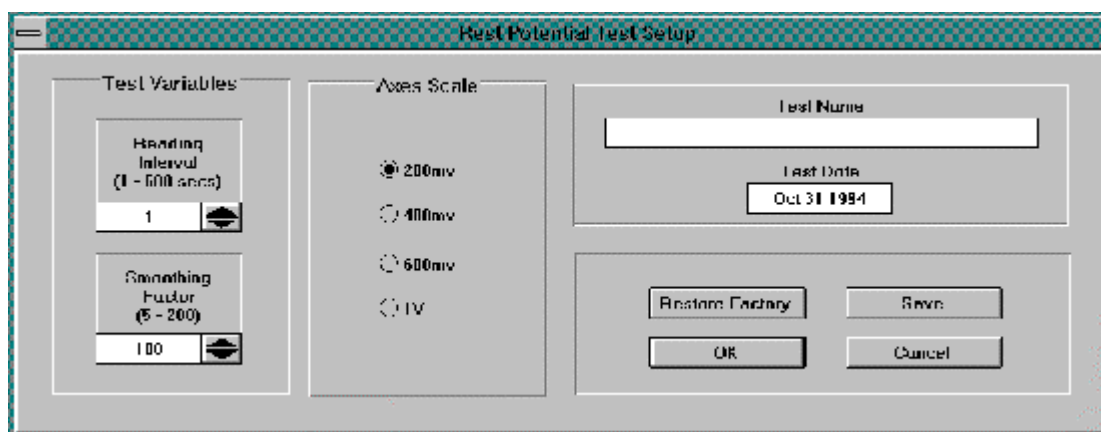
As with all tests performed by PciWin, Rest Potential tests appear in a test window. The sequence to start a Rest Potential test is as follows :-

- Open active test window by clicking on "New Test" on menu bar or Test and New using the Menu options.



- Select Rest Potential from Test menu or CTRL + R, or click on

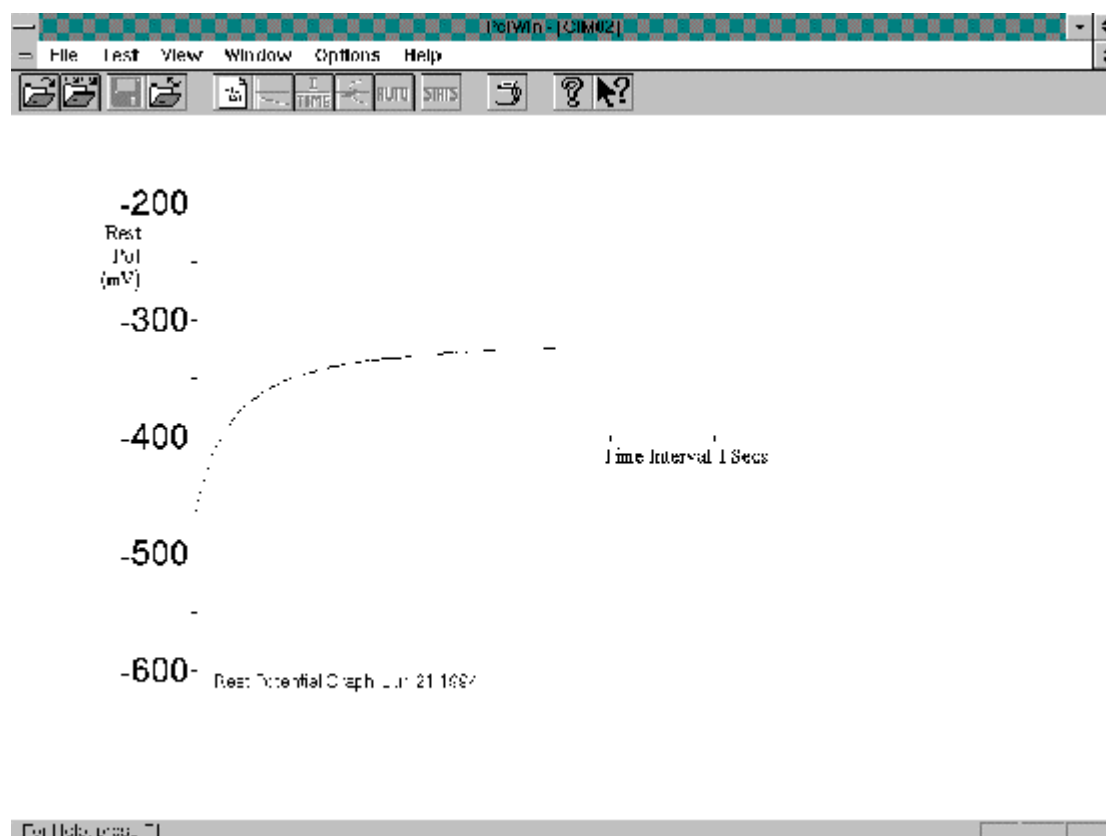
- The default set up box appears as below



The default Rest Potential Test Setup box appears with the cursor automatically flashing in the "Test Name " box. Enter a test name, connect the mini-cell into the instrument and click on OK to proceed.

The factory defaults of 1 sec Reading Interval and 200 mV scaling are held in a separate file , so that clicking on Restore Factory at any time will restore these values. Test duration's can be increased by raising the Reading Interval for inhibitor persistence and stability testing. The Smoothing Factor is preset at 100 as a standard throughout the three modes of testing. Axes scaling is designed to scale the screen ± 200 mV about the first Rest Potential reading to allow for potential drifts with time or to display \pm potential shifts due to additions of surface active agents. Axes scaling can be preset by selecting one of the four possible options using the radio buttons in the Rest Potential Test Setup box .

A typical example of a system responding to an addition of an inhibited solution is shown below:-



This is in fact only half of the curve , a full S curve can be generated by starting the test in water and adding a Semi-Syn or Synthetic fluid to the solution whilst the test is running. Steel in aerated water will exhibit an metal/solution potential of approx -550 mV or -0.55V , when water soluble inhibitors are present adsorption can be seen to raise this potential to typically -330 mV or -0.33V. It is this effect that is graphically visible that allows the instrument to be used to screen possible surface active agents.



5.2

Current-Time

I/T tests are used to :-

- Show the ability of adsorbed inhibitors to resist oxidation or reaction with competing aqueous anions.
- Show selective adsorption at different overpotentials.

As with all tests performed by PciWin, I/T tests appear in a test window . The sequence to start an I/T test is as follows :-

- Open active window by clicking on "New Test" on the menu bar or Test and New using the Menu options.

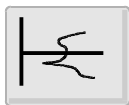


- Select **Current** from the Test menu or **CTRL + C**, or click on

- The default Current Test Setup box appears as below

The default Current Test Setup box appears with the cursor automatically flashing in the "Test Name" box . Enter a test name, connect the mini-cell into the instrument and click on OK to proceed.

5.3



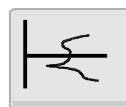
Sweep

Sweep tests are used to :-

- a) Compare performance of proprietary fluids.
- b) Compare dilution sensitivity of proprietary products.
- c) Determine concentration of inhibitors required for trouble free performance in varying degrees of water hardness.
- d) Illustrate synergism of inhibitor systems.
- e) Test recycled fluids for correct dosing of depleted additives.
- f) Illustrate competitive ion effects ie effect of thickeners, EP additives, anti-foams on corrosion inhibitor performance.

As with all tests performed by PciWin, Sweep tests appear in a test window . The sequence to start a Sweep test is as follows :-

- a) Open active window by clicking on "New Test" on the menu bar or Test and New using the Menu options.



- b) Select Sweep from the Test menu or **CTRL + P**, or click on
- c) The default Sweep Test Setup box appears as below

The Sweep Test Setup box can be broken down into three sections :-

- Sweep Style
- Test Variables
- Begin Sweep

Sweep Style

The default sweep style is set for a Ramp One Way standard sweep test . However the sweep style can be preset by selecting any of the four possible sweep options using the radio buttons.

- ☒ Ramp One Way
- ☐ Cycle
- ☐ Centre Cycle
- ☐ Central One Way

Tests on water based fluids and synthetic solutions are normally carried out using the Ramp One Way sweep style, under the Test Variables developed and optimised by BKT for testing of lubricants. The PciWin program automatically loads the Test Variables box with these parameters as default parameters.

Ramp One Way

The default sweep setting , will sweep the Applied Voltage either positive/negative from the limits as defined in the Sweep Range. The Sweep Range is selected in the Test Variables box, and is the voltage range over which a test is performed. ****Note**** the Sweep Range is applied +- about the system's measured Rest Potential.

Cycle

This will execute a Ramp One Way test until the upper limit is reached, then the cycle reverses the ramp direction and produces a second ramp until the lower limit is reached.

Centre Cycle

This operation initiates the Applied Voltage from the measured Rest Potential reading, (as opposed to an upper or lower sweep limit). The ramp will proceed either +- from the measured Rest Potential, until a limit is reached then the ramp direction is reversed, the sweep will pass through the system's Rest Potential and continue until the next limit is reached, then reverse to return to the Rest Potential.

Central One Way

This option reads the system's Rest Potential, then applies +- 200 mV before outputting an Applied Voltage then executes a Ramp One Way test until the upper or lower limit is reached.

e.g.: If the system's Rest Potential is read as -0.5V then assuming a positive ramp direction the test's first Applied Voltage will be applied at -0.7V and a Sweep Range of 1000mV would produce an Applied Range of -0.7V to + 0.3V.

Test Variables

Sweep Range

The voltage range over which the sweep test is to be performed. The sweep range is applied symmetrically about the systems Rest Potential. Valid parameters +- 200mV- 2V.

Increment Size

The magnitude of the change of Applied Potential in mV that is output per increment/decrement of the sweep .

Smoothing Factor

This is the number of readings that will be read from the ADC for each plot point. The readings are averaged to produce a value which smoothes out any double layer transients before screen plotting.

Reading Intervals

The time that will elapse between consecutive plot point readings.

Solution I R Drop Factor

A scaling factor that dynamically adjusts the Y axes scaling to take into account the reference electrode not reading the true applied voltage when testing highly resistive solutions ie HFB fluids and some water glycol fluids. Defaulted to 1.0 for water based fluids.

Corrosion Constant

A scaling factor that dynamically adjusts the X axes to take into account different cell designs and IR drops across the counter and working electrode . (ie the solution resistance)
Defaulted to 1.0 for water based fluids.

Begin Sweep

Defaulted to **negative**

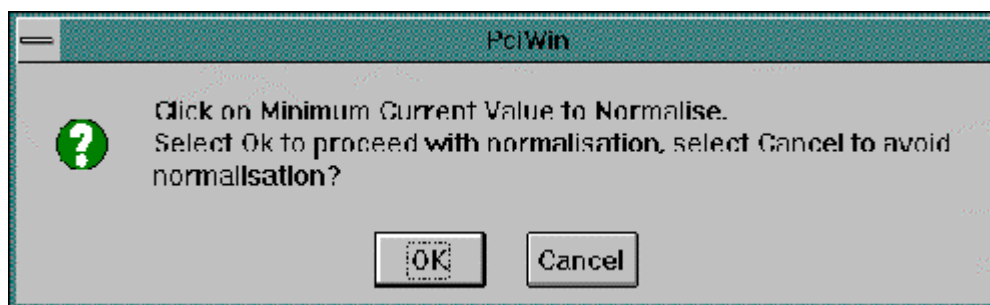
The sweep test will commence by imposing a Cathodic overpotential specifically, the Sweep Range above/below the Rest Potential will be subtracted from the Rest Potential and the resultant voltage is what will be applied between the working electrode (metal specimen) and the calomel reference electrode.

Normalisation of Sweep Tests

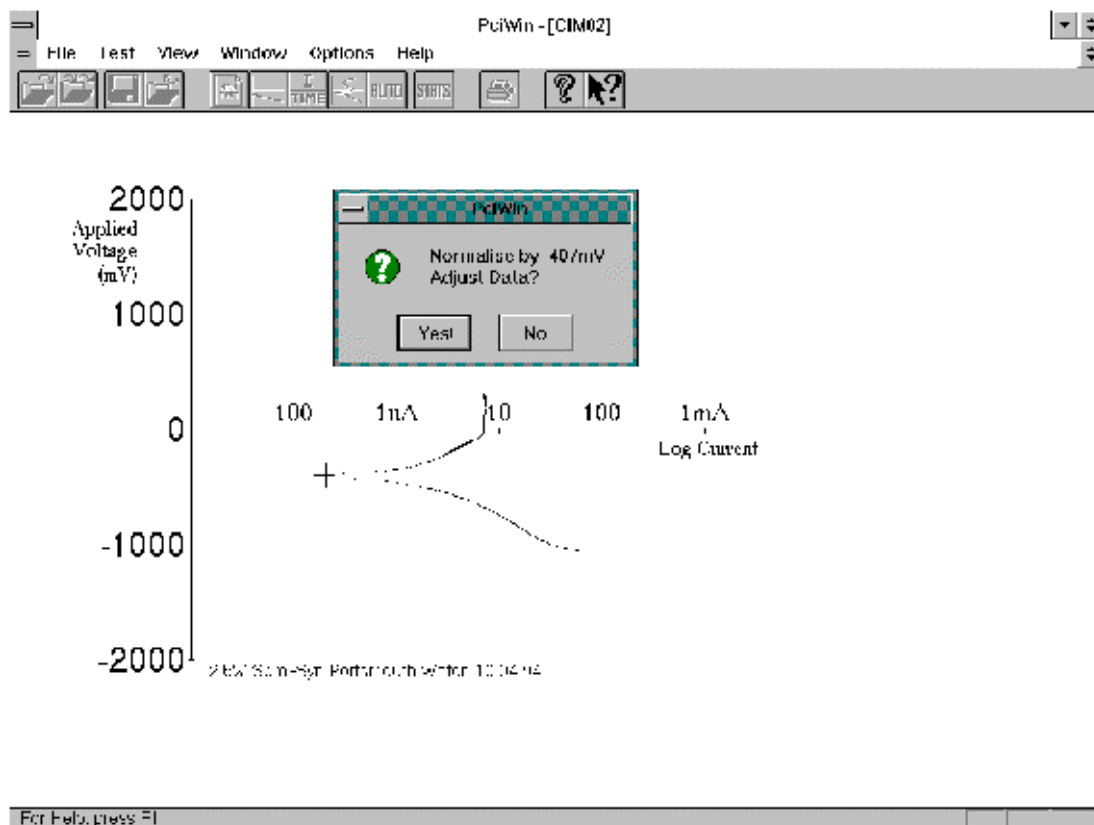
In order to use the advanced features of PciWin's **Overlay and Statistics** facilities we have introduced the term **Normalisation**.

Normalisation of a sweep test allows the user to select a position on the curve (usually the Rest Potential) which is then shifted to the x axes. If the Rest Potential is selected (the minimum current value) the test is further displayed symmetrically about the x axes. Upto four **Normalised** sweep tests can be overlaid in a single Test Window using the Open Multiple option from the File menu.

At the end of a Sweep Test PciWin automatically displays the box below :-



Click on **OK** to proceed with **Normalisation**. The box will disappear and the cursor will change from an arrow to a cross hair (+). Maximise the Test Window and position the cross hair on the minimum current value , once in position double click the left hand mouse button to select. An example screen is shown below :-

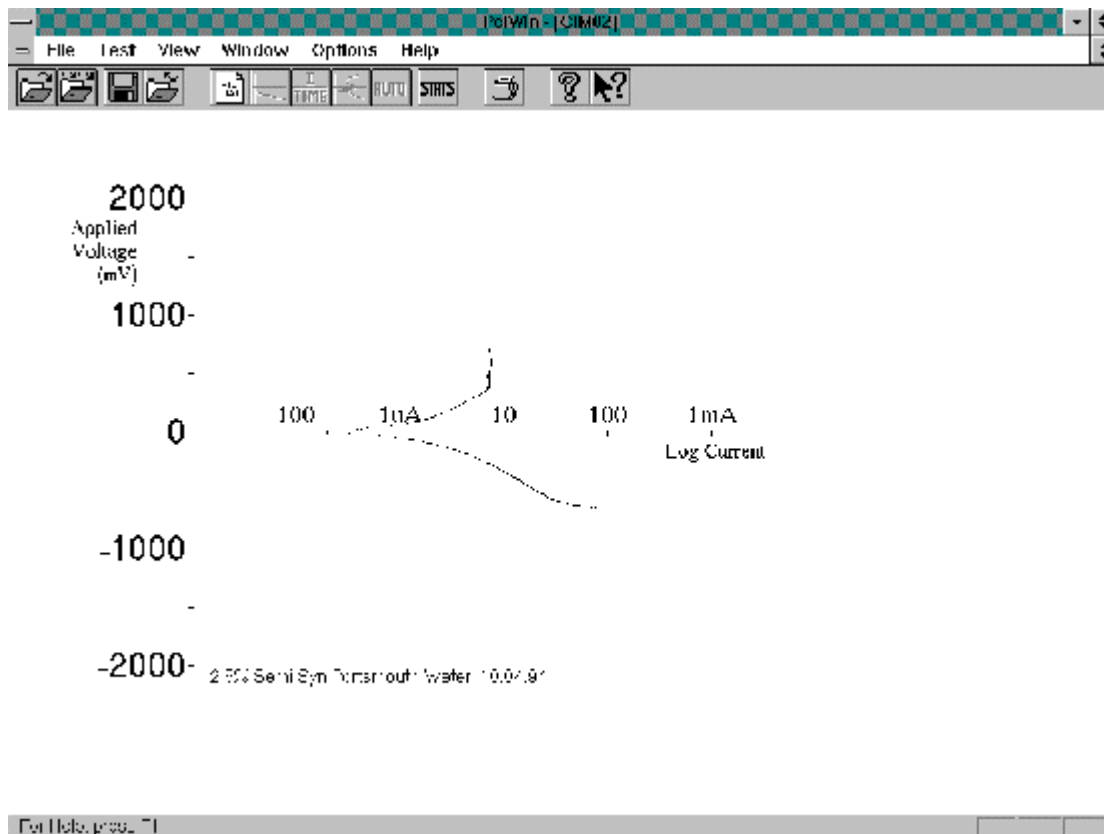


The adjust data offset is displayed in the information box. This value -407 mV or -0.407 V (the system's Rest Potential in this case) will be subtracted from all data points.

Select YES to proceed.

The Test Window will reappear with the sweep test , the value -407 mV has been saved temporarily in the data file associated with the test. Be sure to resave the test in its new form under File _Save or Save _As if renaming. The test file data can be displayed in PciWin by selecting the option Ctrl + V whilst the Test Window is active.

A *Normalised* sweep test is shown on the following page.



Statistics

PciWin will report electrochemical data, corrosion rate statistics and Tafel Slope B_a , B_c values in accordance with Tafel polarisation theory and the **electrochemical mixed potential Tafel extrapolation method**. A detailed explanation of corrosion theory underlying this analysis is beyond the scope of this manual however a simple and clear reference text covering these methods is :-

Gelling P. J
Introduction to corrosion prevention & control for engineers
Delft University Press 1976
Electro Chem Monographs for Teachers Series

Note :-

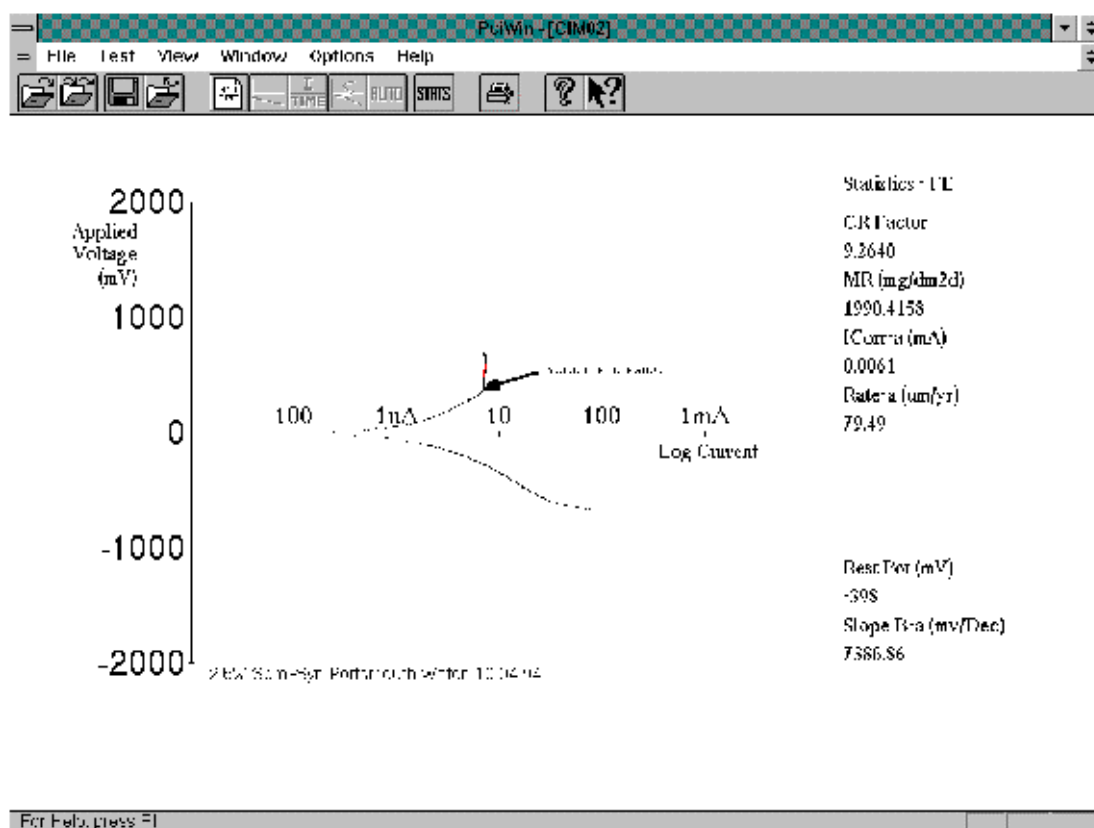
- a) **Tafel extrapolation methods only strictly apply to tests on inhibited and uninhibited steels in acid solutions. As the Tafel equations are written for active polarisation control.**
- b) **Statistics can only be undertaken on Normalised Sweep tests.**

However an indication for comparative purposes of the corrosion inhibition afforded by an oil emulsion system can be obtained by selecting a linear area of anodic film formation on an inhibited sweep test. Select Statistics by clicking on **O**ptions from the file Menu and then **D**o Statistics, or by



selecting from the tool bar.

An example of the statistics screen is shown below :-



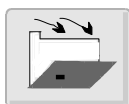
We have assumed here that the point of ANODIC FILM FORMATION , represents the maximum corrosion dissolution current that will flow when the fluid is put into practice. PciWin allows the user to select this point when in Statistics mode . By selecting the most +ve high point for analysis above this point followed by the point of ANODIC FILM FORMATION as the +ve low point the Statistics routine will carry out a "Least Squares" curve fit between the two selected points and will extrapolate a straight line back to the X axes. The value of current at this point (i-Corr ,a) mA is then used in the Statistics formula to return a corrosion rate , Rate-a (um/yr).

Overlaying

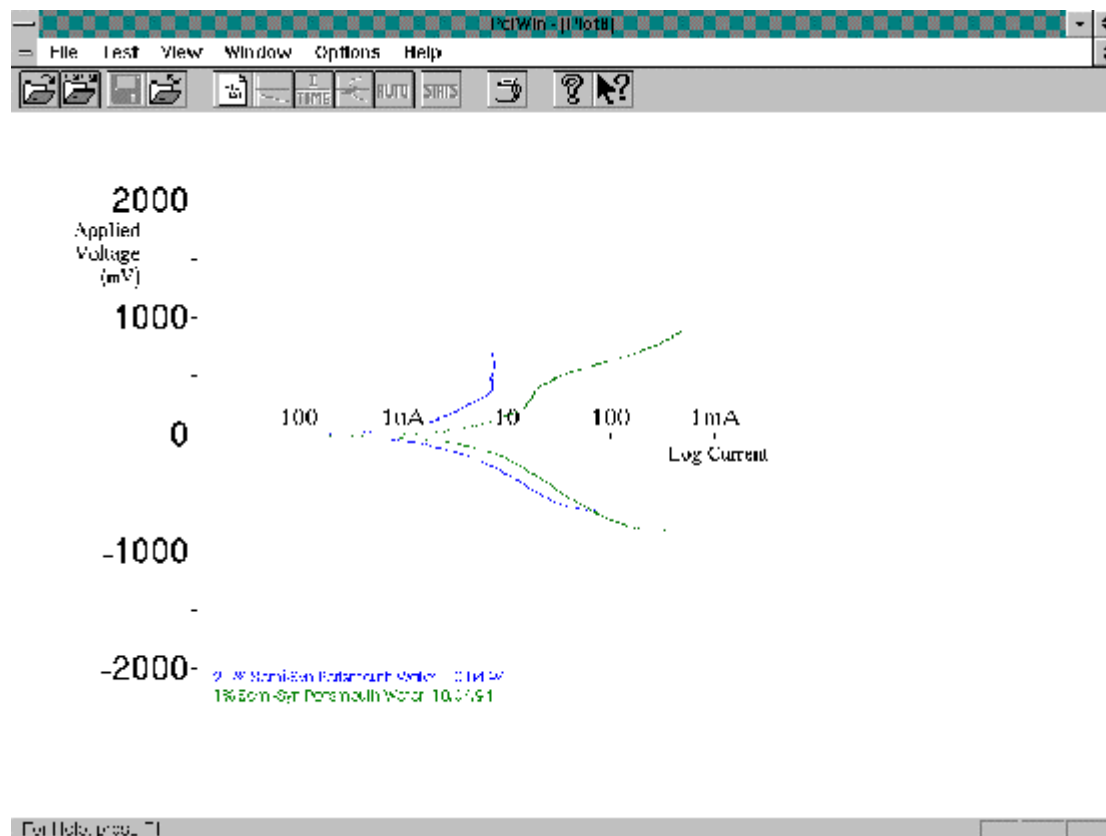
PciWin has the facility to overlay upto four sweep tests (*.pci files) inside a single Test Window. This is typically used to display the effects of dilution on fluid performance and or water aggressiveness at constant dilution.

To overlay sweep tests relative to their individual Rest Potential's it is usual practice to *Normalise* the tests prior to overlaying.

Select overlay sweep tests by clicking on **Open Multiple** (Ctrl +M) from the File Menu , or by



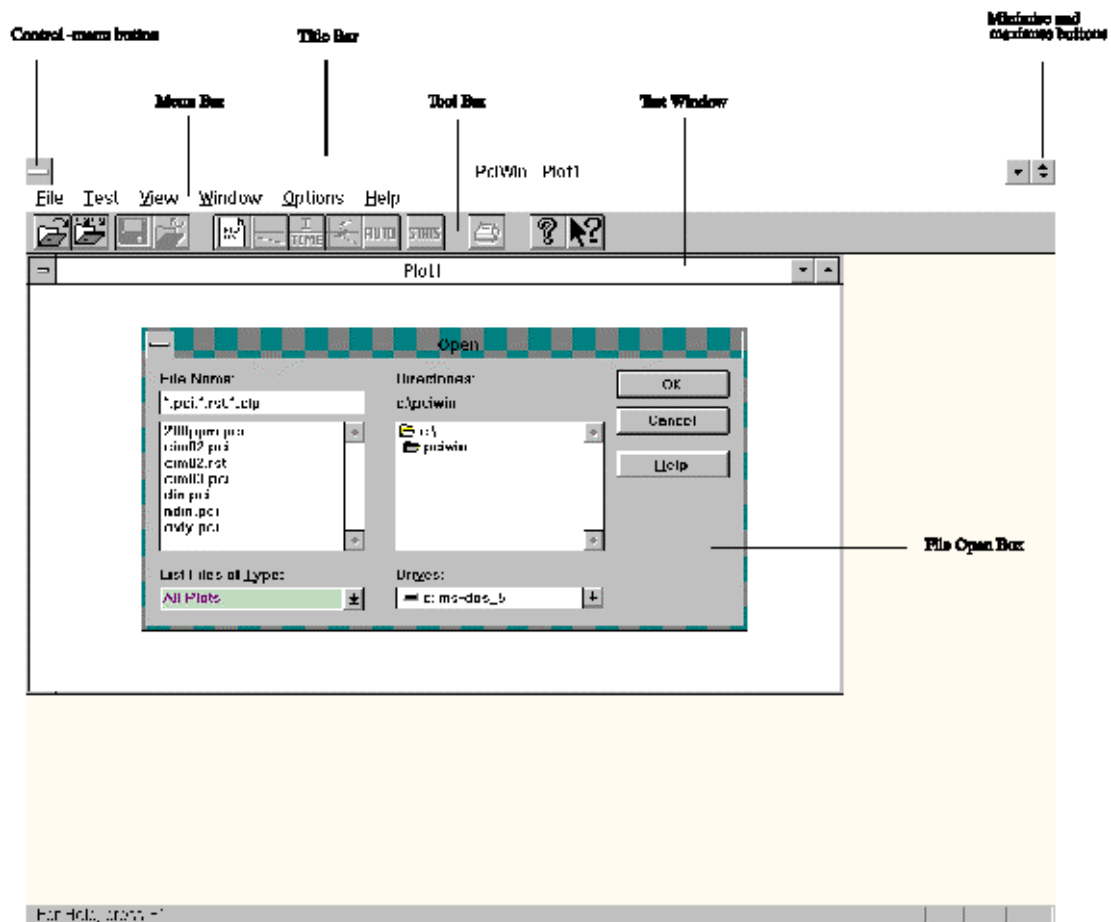
selecting from the tool bar. From the OPEN popup box select upto four sweep tests by using the standard Windows multiple selection procedure (CTRL + Click) the left hand mouse button. After selecting a maximum of four tests to overlay click on OK or press keyboard Return. An example of a Test Window with two overlaid *Normalised* tests is shown below:-



6.0 PciWin SOFTWARE IN DETAIL

6.1 The Main Screen

The main window appears immediately after PciWin is opened . Here we have additionally displayed the File Open box from the **File Open (Ctrl + O)** , Menu bar. The labelled parts of the main window are referred to in the following pages.

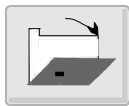


The *Control-menu button* is in the upper-left corner of the window. Clicking on the control menu box displays the control menu which contains commands to resize, move, close windows, and switch to another task running under Windows. Double clicking on the control menu box exits PciWin.

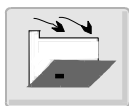
- The *Title bar* contains the title for the window. The title will be PciWin on the main window. Other windows will display File name or Plot number.
- The *Minimise/Maximise buttons* reduces the active window to an icon or enlarges the active window to fill the entire desktop.
- The *Menu bar* contains the PciWin commands. The menu bar groups commands together in menus. Each menu's name appears on the Menu bar. The available menus are File, Test, View, Window, Options, and Help.
- The *Tool bar* is a collection of quick reference buttons which give instant access to many of the menu bar functions .
- A *Test Window* is automatically opened either for displaying a New Test or opening a test file.
- The *File Open Box* displays files held on disc and allows selection of files for screen display inside a Test Window.

6.2 *Displaying Tests*

Tests are displayed by opening test files using the File Open Box . PciWin recognises three File Types, namely *.pci, *.rst, *.ctp which relate to Sweep, Rest Potential and Current -Time tests. The File Open Box can be opened in **TWO** modes, Open and Open Multiple.

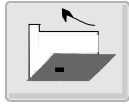


- **File Open (Ctrl + O)** allows the selection of a **Single** test file , and opens a single *.pci, *.rst, or *.ctp test file which is displayed in a Test Window.



- **File Open Multiple (Ctrl + M)** allows the selection of upto four **Sweep Test *.pci** files which can be overlayed inside a single Test Window. Multi-Select inside the File Open Box using the Ctrl + Click Windows mouse function.

The **Import DOS** function in the File menu allows the conversion of old Sweep and Rest Potential files generated on PCI 2000 Ver I instruments into PciWin format. This facility is Pci-Soft version dependant and requires the data to be held in ASCII II text format a facility provided by later versions of Pci-Soft Nov 92 onwards.

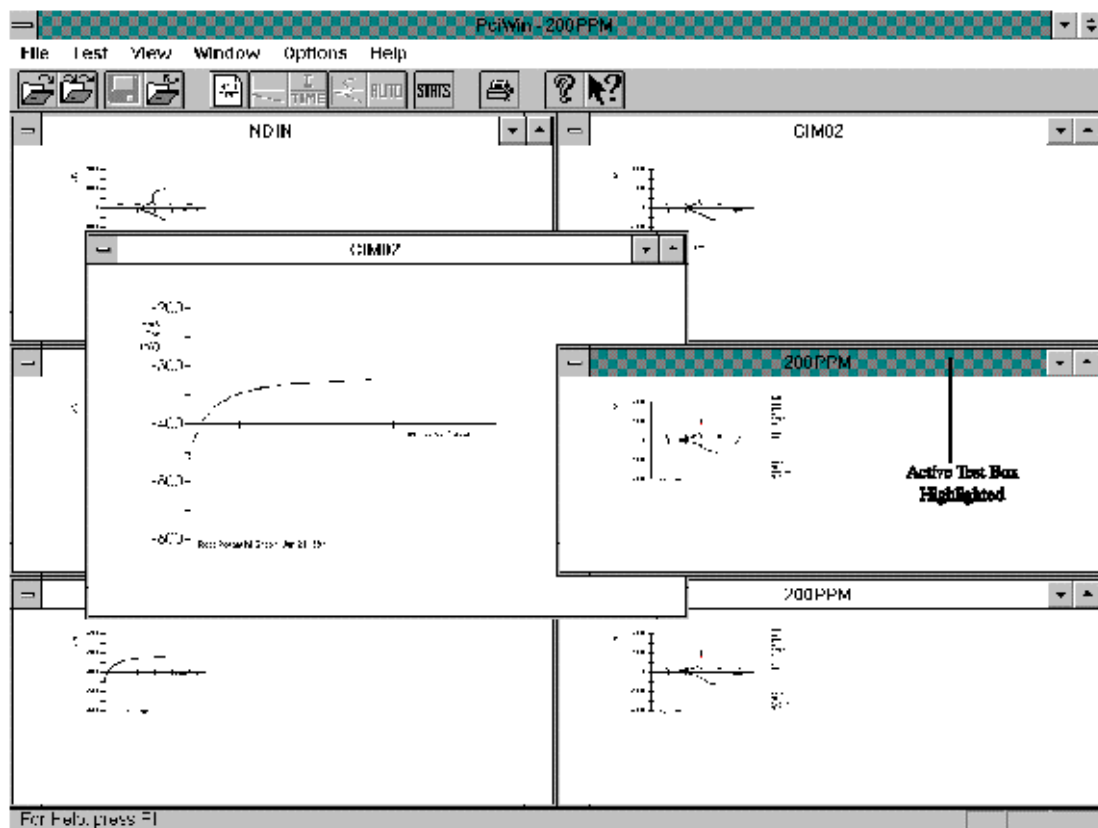


- **File Close (Ctrl + F4)** will close the active Test Window . The focus will shift to the next Test Window in the reverse of the opening sequence.

6.3 Manipulating Tests On-Screen

By repeating **File Open (Ctrl + O)** commands you can open multiple existing tests. The only limit to the number of tests open at one time is the computer system's memory, however a practical limit of 20 is suggested for file manipulation as displaying multiple graphic images has a toll on computer efficiency.

Using the **Window Tile** option from the Menu Bar the tests can be displayed as shown below :-



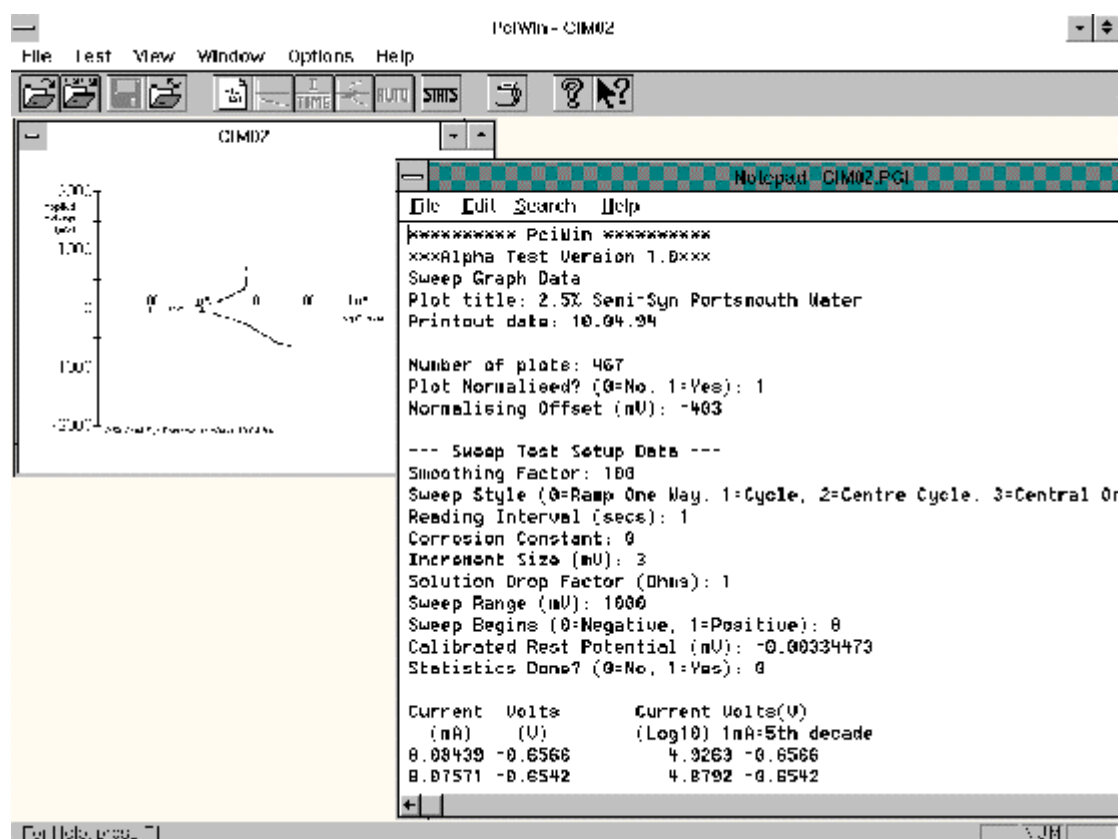
The active Test Box is always highlighted and it's filename appears on the Title Bar at the top of the main window screen. Highlight a new active Test Box by clicking inside a Test Window.

Manipulation of Test Window box's obey the same rules as per sizing, resizing and moving of any Window as detailed in your Windows 3.1 "User's Guide".

To move a Test Window , click the mouse inside the Title bar and drag the window to it's new location. The **Window** option from the Menu Bar lists 1-9 Test Windows and displays **more** if there is greater than 10 Test Windows open. Click on **more** to browse 10+ tests.

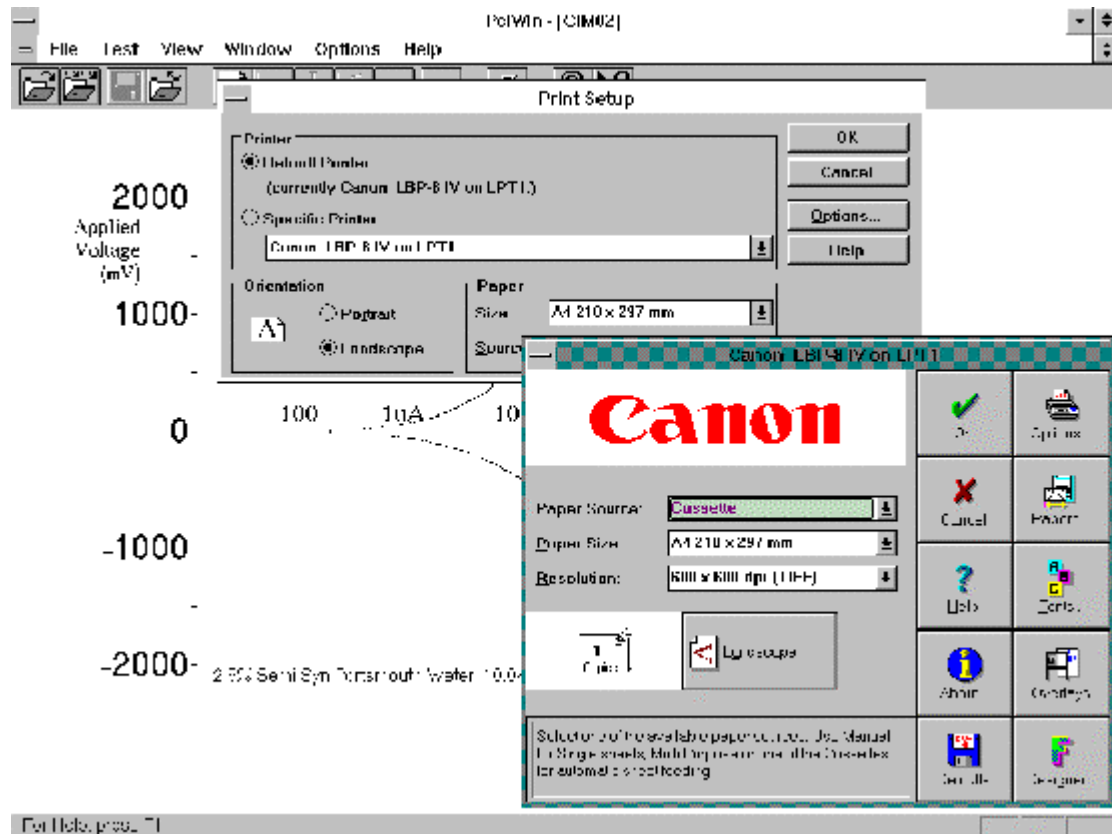
6.4 Viewing Test Window data

The **File View/Print Text (Ctrl +V)** option in the menu bar displays the test data associated with the highlighted active Test Window. Selecting this option automatically opens Windows Notepad and the data file associated with the active Test Window. A printout of this testdata can be obtained using the **File Print** option in Notepad's menu bar.



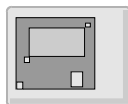
6.5 Printing the Active Window

The **File Print Plot** option in the menu bar prints the active Test Window using Windows Print Manager. The Windows printer setup can be displayed from within PciWin using the **File Print Setup ...** option.



This screen shows an example printer setup for a Canon LBP-8 IV laser .

6.6 Saving Tests to Disc

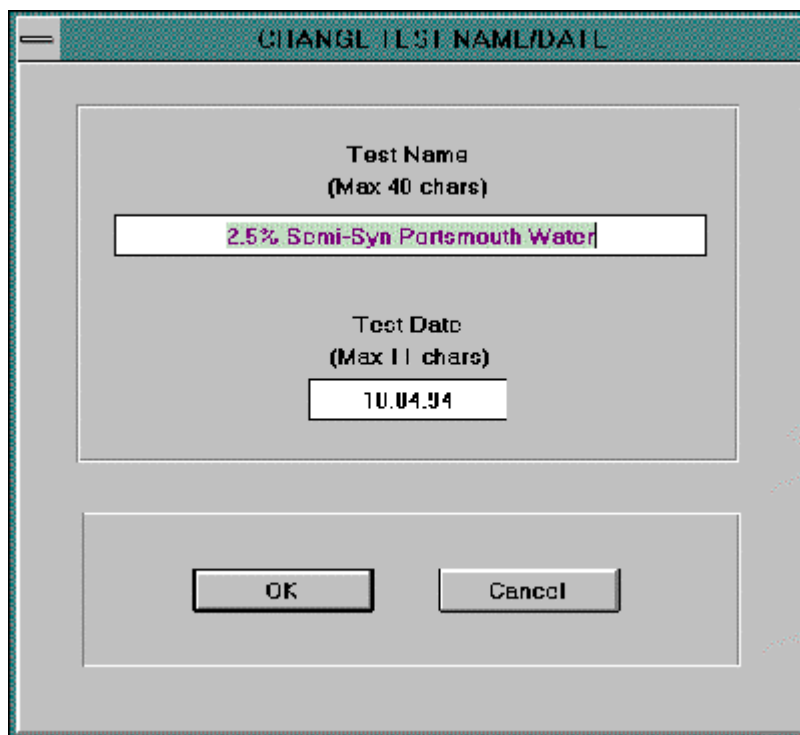


- **File Save** option from the menu bar saves the active Test Window to disc , provided the test is a New Test. If the test has been saved previously then the quick button will not be active and the test can only be saved using the **File Save As ...** option.

6.7 *Changing the Test Name and Date*

The **Options Change Name/Date (Ctrl + D)** option in the menu bar allows the user to retrospectively alter the Test label associated with the Test Window. The Test Name must not be confused with the Test File name which can only be changed using the **File Save As ...** option.

The Test Name can be altered by typing a new set of labels inside the CHANGE TEST NAME/DATE box.



6.8 *Positioning X-axis Labels*

The **Position X-axis Labels...** option will position the x axes labels if obscured by test data.

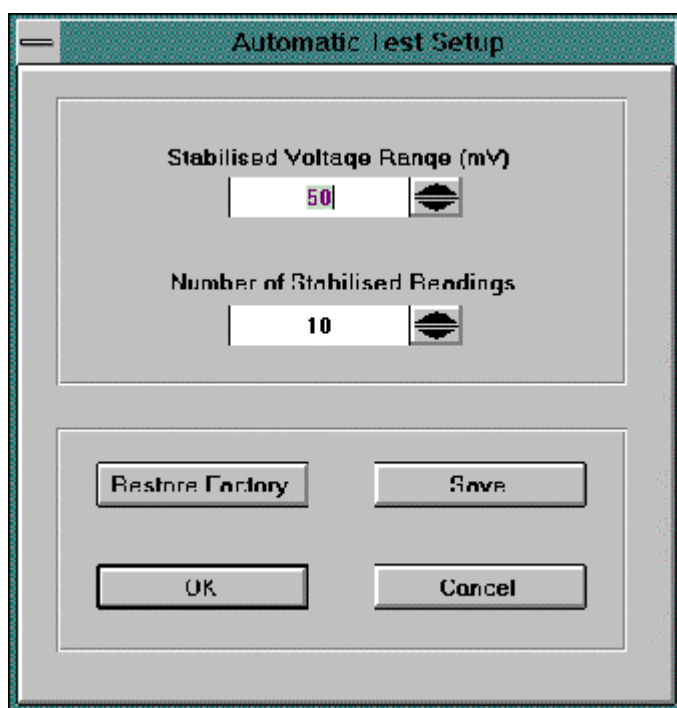
The three positions available are:-



<u>T</u> op of Window	Ctrl + T
<u>A</u> bove X-axis	Ctrl + X
<u>B</u> elow X-axis	Ctrl + B

7.0 THE AUTO TEST FEATURE

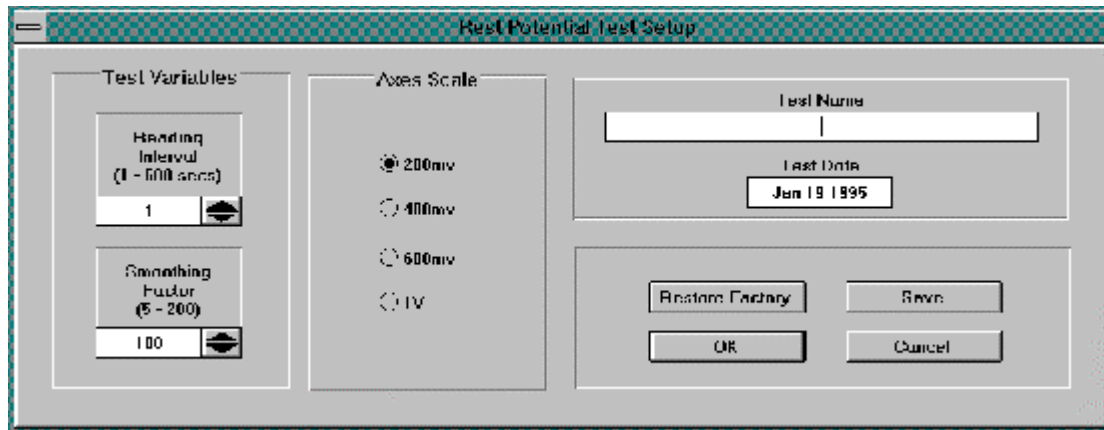


- **Test Automatic (Ctrl + A)** option from the menu bar enables the auto test feature of PciWin. The auto test feature is designed to test the system for stabilisation automatically using a conditional Rest Potential test procedure followed by an automatic Sweep Test when the stability conditions as set out in the Rest Potential test criteria have been met. The Automatic Test Setup box allows the user to define conditions of stability for consecutive metal/solution potential readings. The test then applies these conditions in an either/or conditional way until such time as the stability conditions are met. When the system has stabilised the auto feature starts a Sweep Test as defined in the Sweep Test Setup box.



Using the quick test buttons click on  followed by  to initiate an automatic test. Select the sweep setup conditions as requested in the Sweep Test Setup Box and select a window of acceptance for voltage readings defaulted to 50 mV and the number of readings required to fall within this window defaulted to 10.

Select the required test variables from the Rest Potential Test Setup box and click on OK.



The image shows a software dialog box titled "Rest Potential Test Setup". It is divided into three main sections. The left section, labeled "Test Variables", contains two sub-sections: "Reading Interval (1 - 500 scans)" with a value of "1" and a slider, and "Smoothing Factor (5 - 200)" with a value of "100" and a slider. The middle section, labeled "Axes Scale", has four radio button options: "200mV", "400mV", "600mV", and "1V", with "200mV" selected. The right section contains a "Test Name" text field, a "Test Date" field showing "Jan 19 1995", and four buttons at the bottom: "Restore Factory", "Save", "OK", and "Cancel".

PciWin will initiate a test based on these preselected test variables and test conditions. The Rest Potential test will read metal/solution voltages until ten readings are read to be consecutively within 50 mV difference, upon such time the auto feature will start a Sweep Test.