



AlcoTest™

Users' Manual Rev B

Software V1.0.3.0 and above

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## 1. Introduction

Thank you for the confidence you have placed in Rudolph Research Analytical and for the purchase of our precision AlcoTest™ system. The AlcoTest™ is designed to provide accurate measurement of alcohol content in both obscured and unobscured liquids.

Rudolph's AlcoTest™ units are the world's most advanced, with many exclusive features which include:

- Windows Embedded Operating System Maximizes Flexibility and Features
  - With the AlcoTest™, the display, the printout, and the saving of measurement results are completely flexible and may be tailored to meet the end user's requirements. Any printer may be used, either some local printer sitting next to the AlcoTest™ or some networked printer in a completely different building. The same is true for how and where the data is saved. And the AlcoTest™'s display is large, bright, and completely configurable. The AlcoTest™ is capable of all the same flexibility and features that would be available to you with the use of a PC running in Windows® embedded. Embedded Windows means that your AlcoTest™ is completely safe from all malware and viruses.
- Peripherals and Networking
  - The AlcoTest™ has 5 USB ports, an Ethernet cable connection, one RS232 port and will communicate immediately with any USB external keyboard, mouse, bar code scanner, plug-and-play USB printers and any other USB devices.
- Easy Transfer of Data and Firmware Upgrades
  - The AlcoTest™ can either use a flash memory stick or exchange information directly from the Internet. Special formulas or tables required for an application may be downloaded directly from the Rudolph Research Analytical web site to the AlcoTest™ instrument in your lab. The same is true for any required software or firmware upgrades via the use of a preloaded desktop sharing utility.
- Virtually Unlimited Resources Available

- With its 32 GB memory, the AlcoTest™ has virtually an unlimited number of special tables, formulas, methods, and also customized calibration checks and adjustments available for use.
- Remote Troubleshooting and Diagnostics
  - Using a desktop sharing program, Rudolph's Service Department and RRA Authorized Trained Personnel may connect to your equipment from thousands of miles away and provide immediate assistance to the end user in the most convenient manner.
- Touch Screen User Interface
  - The AlcoTest™'s display is large (10.4" diagonal), bright, colorful, and completely configurable.
- The Graphic User Interface is Very User Friendly
  - All functions required for measurements and daily operations are directly available to you on the main screen; no need to go into other menus or submenus. The AlcoTest™ is the most user friendly, intuitive precision alcohol testing system in the world.

## 2. Safety Considerations

No manual can address all the various hazards which may be possible in each laboratory's environment especially when considering the vast array of different chemicals which may be present. It is ultimately the user's responsibility to establish the appropriate health and safety regulations. The following are basic guidelines which apply to most all laboratory instrumentation.

Read the manual before using your Rudolph AlcoTest™ and contact Rudolph Research Analytical directly with any questions or concerns. Do not install the AlcoTest™ until completely familiar with this instrument and its functions.

Always ensure that the power source to the instrument is properly grounded.

Switch the AlcoTest™ unit off and unplug the power cable before doing any authorized maintenance to the AlcoTest™.

Only technicians trained by Rudolph Research Analytical are permitted to perform any necessary repairs or service. Any and all parts used for this service and any software used must be specified by Rudolph Research Analytical.

The AlcoTest™ has been designed with operator safety in mind. Toward that end operators are advised to follow best practices and operating procedures as recommended by OSHA for their particular laboratory environment and for laboratory safety in general. The relevant specifications are referenced in detail in chapter 15 of this document. As a brief summary the following points should be observed.

- The AlcoTest™ operation manual is a reference for the safe operation of this equipment. It is not intended to be either comprehensive or exhaustive. When in doubt the local processes and procedures should be construed as to supersede the safety practices recommended in this manual.
- It is highly recommended that operators of this equipment read the manual in its entirety and be familiar with the operation of this unit prior to use.
- Rudolph Research Analytical provides a comprehensive warranty on this equipment. For warranty details please consult your enclosed documentation. Please note that this warranty may be compromised if



alterations have been made to the unit's mechanical or electrical parts or software.

- The AlcoTest™ unit is a precision piece of equipment. Please take care to follow all instructions, warnings and tips to ensure the safe operation of this equipment.

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*Note: In the event that a situation arises that is not covered in the manual or the documentation please consult directly with an authorized representative of Rudolph Research prior to attempting the desired operation.*

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- Please do not use the equipment in a manner that is proscribed within the manual. Rudolph Research will not be liable for damages to customer premises or personnel in the event that the unit is used in a proscribed or incorrect manner.
- Rudolph Research approved accessories that are shipped with the unit, and/or purchased subsequently for use with the equipment are the only devices which may be employed. Using unapproved devices within the equipment is prohibited and may affect your warranty.
- AlcoTest™ units consist of a display base and an Optics Box Module. Both components are designed to be easy to install and maintain. Please note that only an approved installer and or approved maintenance personnel should attempt to either install or maintain the AlcoTest™ unit.
- The AlcoTest™ unit should not be operated if any damage or malfunction is suspected. In the event that a unit has become suspect in its operation please disconnect the unit from the mains power source and contact a Rudolph Research Approved support outlet for further instructions.
- The AlcoTest™ is not designed to meet the UL1230 Explosion Proof Equipment standard. (See chapter 15 for further details). Please do not operate the equipment in an environment which requires machinery to meet this standard.
- Any and all required service or maintenance on this equipment *MUST* be performed by authorized Rudolph Research Service personnel. This does not include regular cleaning but does include any operation where the external covers of the unit are opened.



- It is very important that all operators are fully trained in the operation of the equipment prior to use.

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*Note: Due to the nature of precision measurement, results may be influenced by environmental factors or other local conditions. In the event that your AlcoTest™ unit is not functioning to the specifications that are expected please contact Rudolph Research prior to taking any action.*

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### Flammable Liquids

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*NOTE: When using inflammable liquids near the equipment or for testing or cleaning purposes please follow the following precautions.*

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- Do not store flammable material near the equipment. This includes materials which may contribute to the severity of an incident, such as lab coats, packing material or papers.
- Do not leave flammable sample containers or solvent containers uncovered.
- Spillage of flammable solvents, samples and or cleaning materials should be addressed immediately. Please do not operate the equipment in the event of a nearby flammable liquid spillage.
- Ensure adequate ventilation if the AlcoTest™ is to be used with noxious and/or flammable liquids, vapors or solvents.
- Follow best practices with regards to the connection of this equipment to the mains power when used with flammable liquids. It is recommended that the local fire safety ordinances be consulted and that all required fire safety inspections be conducted prior to operation of the equipment in a flammable liquid environment.
- Fire extinguishing equipment and/or fire suppression equipment, as required by local ordinances or fire safety codes, should be installed and operators should be familiar with their operation prior to using this equipment in a flammable liquid environment.

- Never leave the equipment unattended when it is operated in an environment where flammable liquids are present.

Follow all warnings and instruction in this manual.

Do not work in any hazardous area. Work in a fume hood when measuring any materials which are inflammable, toxic, or corrosive. As previously mentioned - the AlcoTest™ is **NOT** explosion proof. Comply with all usual regulations when working with materials which could ignite or explode from a spark.

Use caution when using the liquid density standards. Be sure to read and understand the Material Safety Data Sheets which are supplied with these items.

Do not operate the AlcoTest™ if any malfunctions are suspected or detected. Please contact Rudolph Research Analytical.

Be sure all operators of the AlcoTest™ have been properly trained.



Only use the accessories and auto-sampling devices supplied or approved by Rudolph Research Analytical.




### 3. Unpacking your new Rudolph AlcoTest™



#### 3.1 Items Supplied



Your new Rudolph AlcoTest™ system has been packed and inspected thoroughly prior to shipment. However, please inspect the box for damage prior to opening. Photograph if possible the condition of the box if any damage is evident and report this to the transportation company as well as your Rudolph Research Analytical representative. Keep all packing material for inspection.

Standard Items supplied for each AlcoTest™ are as follows:




Item	Pcs.	Description & P/N
	1	AlcoTest™ 2911 Plus – P/N A25593 AlcoTest™ 2911 – P/N A25591 AlcoTest™ 2910 – P/N A25590 AlcoTest™ 2909 – P/N A27146
The No Charge Kit supplied includes all the following items:		
	1	Power Supply 85 to 220vac; 48 to 62 Hz input DC, 12V 10A, 150W MAX output P/N P23274

	1	<p>Power Cord 6' 3 X 18AWG 2.5A/125VAC P/N P23275</p>
	1	<p>Plug Adapter IEC C14 Plug to IEC CS P/N P23722</p> <p>May be required to permit the power supply to be compatible internationally</p>
	1	<p>Optics Box Module (shown with Presser) – detail is view of the Sapphire Prism sample stage of the OBM</p>




	1	<p>Back of the OBM showing connections to the Display Base and to the Presser Head unit.</p>
	1	<p>Factory IQ/OQ Documentation P/N CD00137</p> <p>In addition to this hardcopy an electronic version is also stored as a Read Only File within the AlcoTest™ AlcoTest™'s Memory</p>




	<p>1</p>	<p>Users' Manual – Hard Copy P/N MD00367</p> <p>An Electronic Copy is also stored in AlcoTest™'s memory</p>
	<p>1</p>	<p>Lab Manager's Password</p> <p>P/N CD00135</p> <p>Unique password for each unit provides Manager's level of security</p>





	1	<p>Waste Collection Jar, 500ml Polypropylene P/N A22357</p>
	6	<p>3 ml Luer Slip tip Syringes, With Elastomeric tipped plunger P/N P23016 – Sterile (as shown) P/N P28283 – Not Sterile</p> <p>Suitable for use with Acetone but will be attacked by Toluene, Heptane, Xylene, and similar solvents.</p>
	6	<p>3 ml Luer Slip Tip Syringes, All plastics P/N P23438</p> <p>Suitable for use with most solvents and petroleum applications.</p>



	<p>2 each</p>	<p>Top: Female Luer to 1/4"-28 thread The inlet nozzle comes supplied with this part as standard ETFE - P/N 25571</p> <p>Bottom: Female Luer Lok to 1/4"-28 thread ETFE - P/N P21850</p>
	<p>2</p>	<p>Barbed to 1/4"-28 thread, UNF Outlet Nozzle for waste hose ETFE - P/N P23225</p>
	<p>1</p>	<p>6 feet of Silicone Tubing 1/8" ID x 3/16" OD Waste hose and Air Drying Hose P/N P23279</p>




	2	<p>Plug, Male Luer</p> <p>P/N P21799</p>
	4	<p>Hose Barbed to Male Luer</p> <p>1/8" Polypropylene</p> <p>P/N P23095</p>
	2	<p>Fill Nozzle, PTFE</p> <p>P/N 25583</p>




	1	<p>Nozzle Repair Tool P/N A25649</p> <p>For re-shaping the tip of the above Fill Nozzle should it become bent or damaged</p>
	1	<p>Screw Driver, Phillips head P/N P23280</p>





Please check and make sure all the above items are received. Contact your Rudolph Research Analytical representative if any of the above items are missing. Also, confirm all line items are received per your packing slip.



## 4. Optional and Spare Parts



Item	Pcs.	Description & P/N
	100	3 ml Luer Slip Tip Syringes, with elastomeric tipped Plungers - P/N P23016, Box of 100 pcs, Sterile or 3 ml Luer Slip Tip Syringes with elastomeric tipped plungers – P/N P28283, bag of 100pcs – Not Sterile
	100	3 ml Luer Slip Tip Syringes, all plastic, non-sterile Sold in lots of 100pcs. P/N P23438
	1	Syringe Needles, Non Sterile Blunt Tipped Sold in a bag of 50 pcs. P/N P23897

	1	<p>Top: Female Luer to 1/4"-28 thread The inlet nozzle comes supplied with this part as standard ETFE - P/N 25571</p> <p>Bottom: Female Luer Lok to 1/4"-28 thread ETFE - P/N P21850</p>
	1	<p>Barbed to 1/4"-28 thread, UNF ETFE P/N P23225</p>
		<p>Rinse Bottles</p> <p>Ethanol Rinse Bottle P/N 26367</p> <p>Water Rinse Bottle P/N 26368</p> <p>Acetone Rinse Bottle P/N 27183</p>

	1	USB Mouse (If delivered, may vary in its model)  P/N P23282
	1	USB Bar Code Scanner (If delivered, may vary in its model)  P/N P21776
	1	USB Keyboard (If delivered, may vary in its model)  P/N P23283
	1	USB Laser Printer Kit P/N A23284  Consisting of: B/W Laser Printer, P/N P22078 USB Cable, P/N P23022

	<p>1</p>	<p>USB Ink Jet Printer Kit P/N A23535</p> <p>Consisting of: Inkjet Printer, P11787 USB Cable, P23022</p>
	<p>1</p>	<p>Serial Printer Kit – P/N A26292 (includes ink &amp; paper)</p> <p>Serial Printer sans ink &amp; paper P/N A22185</p>
	<p>1</p>	<p>Fluke Hart Thermometer Kit P/N A23459</p> <p>Consisting of: P/N P23460 1523 Handheld P/N P23461 5622-10 Temp. Probe &amp; 1923-10 Probe Calibration</p>



	1	<p>USB 4 Port Expansion Hub P/N P23463</p> <p>Model May Vary</p>
	1	<p>Automation/Manual Feed Kit P/N A22792</p> <p>Consisting of:</p> <p>2pcs. P/N P22386 – Fitting, Female Luer, 1/4" – 28 male, Stainless Steel</p> <p>2pcs. P/N A22727 – Quick Connect, Modified, Luer Lock, 1/4"-28 female</p> <p>Threads are sealed using Teflon tape</p>

## 5. Setting up the Instrument

### 5.1 Basic Set Up

The AlcoTest™'s power supply may be plugged into any electrical outlet which provides 85 to 260 volts at 48 to 62 Hz. The power supply's output is 12 volts, 150 watts. This power supply and the power cord are both found inside the cardboard accessory box. The On/Off switch for the AlcoTest™ is also in the back near where the power cord plugs in. Once turned on, it will take a few moments for the software to boot-up. See the Back View of the instrument, Figure 5.1 below.



*Figure 5.1 – Back View of RRA AlcoTest™*

The AlcoTest™ is best to be at the ambient temperature prior to turning on. Normally a warm-up time of 15 to 20 minutes is best for accurate measurements.



HINT

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*After shipment, it is advisable to check the instrument's accuracy with air and water prior to making other measurements. If required, do a Two Point Air and Water Calibration Adjustment. Please see Chapter 9.3 on page 54 of this Manual for Complete Instructions.*

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The filling nozzle, which comes pre-installed on the unit, will accept either a Luer Slip tipped syringe or a Luer Lok tipped syringe. See the Side View, Figures 5.2 and 5.3.

The connection between the glass U-tube and the nozzles must be air tight. This connection was checked at the factory prior to shipment. However, it is advisable to recheck these connections as follows: Close off the outlet hose barbed nozzles with your thumb. See Figure 5.4. Then with an empty syringe push air into the nozzle using a moderate amount of force. Hold the syringe's plunger in for a few seconds. Then release the plunger on the syringe. If this connection was air tight, the pressure inside the U-tube will push the plunger back to the original position. See figure 5.4 as shown on page 19.



Figure 5.2 Side View of Drying Hose



*Figure 5.3 Side View of Filling Nozzles*



*Figure 5.4 Checking the Filling Nozzles for Air Tightness*

## **5.2 Setting up the Optics Box**

The AlcoTest™ comes standard with a precision Optics Box Module used for measuring the Refractive Index of the test fluids. The OBM should be connected to the Display Base of the AlcoTest™ as shown below

### **Unpacking and Connecting the OBM**

Carefully unpack the Optics Box Module and accessories from the packing carton. Save the carton for possible re-shipment of the unit. You should have:

- This user's guide
- The optical module with presser
- The refractometer power unit;
- A power cable

### **Parts Guide AlcoTest™ Optics Box Module**

1. Optical Base Module
2. Presser plate
3. Power Supply to AC cable
4. OBM-DBM cable
5. Manual



*Figure 5.5 – AlcoTest™ Optics Box Module – shown with presser installed.*



### **OBM Connections**

The OBM should be connected to the AlcoTest™ display base with the OBM to Display base cable (provided). The Presser should also be connected to the Optics Box base via its cable. The correct cabling is shown below.



*Figure 5.6 – OBM to Display Base (on right) and Optics Box to Presser cable (on left)*

## **5.2 Adding Peripherals; Bar Code Scanner, Keyboard, Printer**

The 5 USB ports make possible the connection of optional peripherals. Barcode scanner, keyboard, mouse and any other USB devices will all be plug-n-play and installed just as one would install the same in any PC. Many printers will also be plug-n-play but if not the printer's universal driver may be installed in the same manner as with any other PC. You may use any of the five available USB ports for any peripheral. Three USB ports are located in the back of the AlcoTest™ and 2 USB ports are on the front.

## **5.3 Turning On – Menu Basics**

Connect the AlcoTest™ unit to a mains power source and turn it on by placing the ON/OFF switch into the ON position. Wait while the unit loads its software

program. Once the software load is complete (about 20-30 seconds) you will see the following Main Screen display.

There are several areas of note on the Main Screen of the instrument.



Figure 5.7 – Main Screen Features

Each of these is described below:

- **Instrument Display:** This area will show the Current Measurement Results
- **Current Method & Settings:** This area will show the currently selected method and any specific changes such as Cell Temp, Set Temp or Sample Id.
- **Time and Date Display:** This area will show the current Time and Date
- **Start Button:** This button will start the measurement using the currently selected method
- **Function Buttons:** These buttons allow the user to select the various functions and menus to configure the unit operation.
- **U-Tube Video Display:** This area shows a real-time video image of the unit's U-Tube sample measurement area to allow the user to see if the sample has been loaded correctly and verify that there are no air bubbles in the sample



The Main Menu of the AlcoTest™ unit is accessed by clicking on the Menu button on the left-hand side of the Function Button Area.

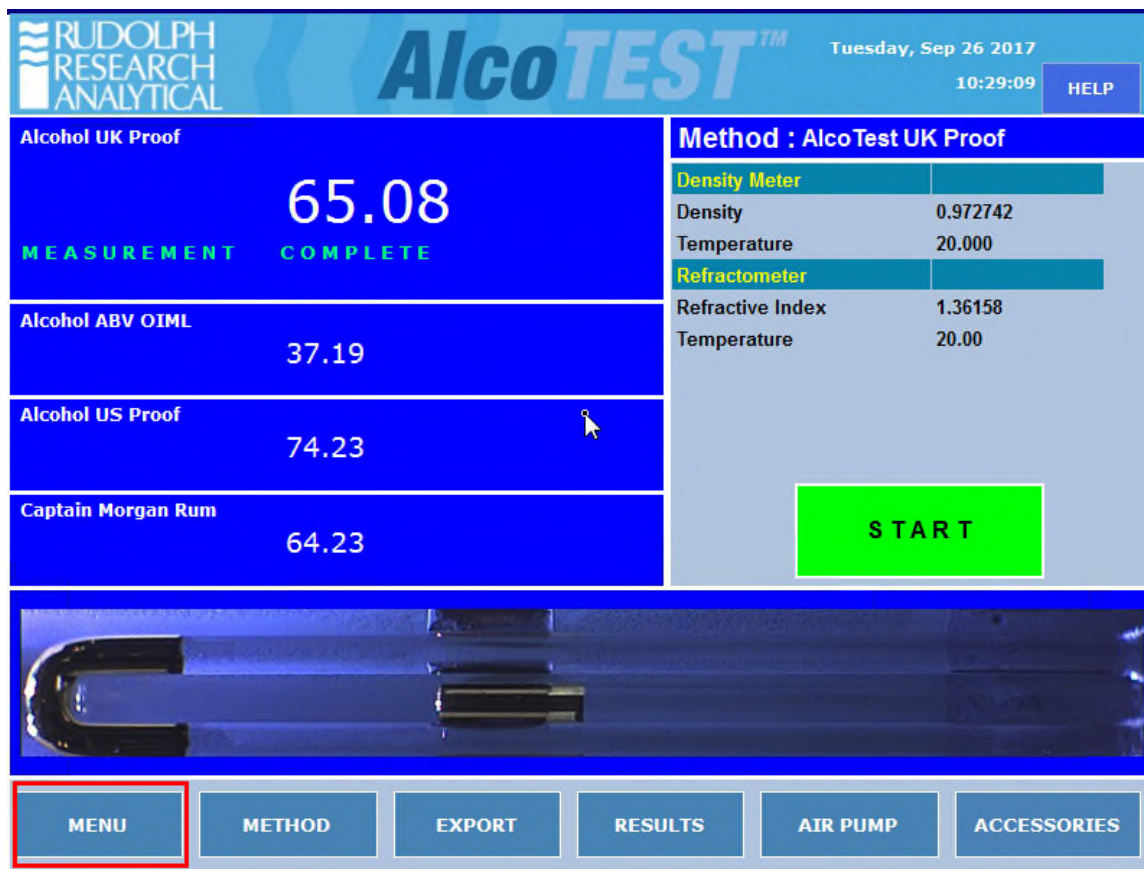


Figure 5.8 – Home - Main Screen - Access Menu

Press the Menu button. If enabled the password dialog box will open. The factory default password is '123'. This password can be changed or optionally turned either on or off by your administrator.

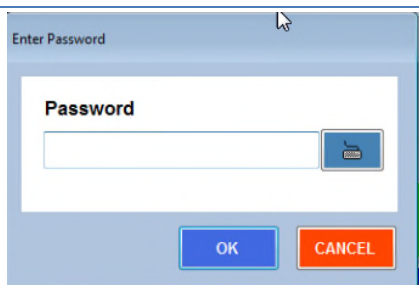



Figure 5.9 – Password Entry Dialog – Default Password is '123'



HINT

*TIP: If you do not have an external keyboard – press the  icon – this will launch an on-screen keyboard where you may use the touchscreen to enter in the password information.*

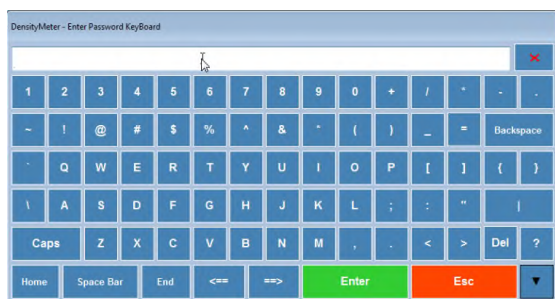


Figure 5.10 – Virtual Keyboard

Typing in the password, if required, will gain you access to the Main Menu, which looks like the windows shown below in Figure 5.8. See Chapter 6 for additional details.

If you wish to turn password protection on or off, please see the Lab Manager's Confidential Envelope – Document CD00135.

## The Main Menu

The main menu provides the user with access to the configuration options and management options of the AlcoTest™. Each part of the menu has various sub-menus and dialogs that will be further explained below.

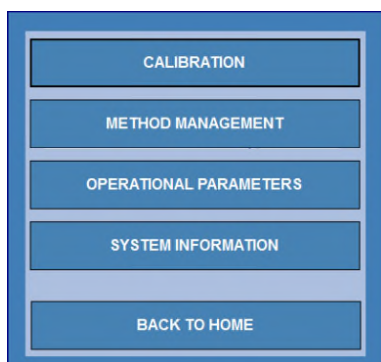


Figure 5.11 – Main Menu

## System Information

Within the submenu “System Information”, you will find software and firmware version information, the system serial number and 21 CFR module version\* as shown in Fig 5.12 – your information will likely not match the information shown below.



Figure 5.12 – System Information

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*\* **Note:** 21 CFR Part 11 module is normally never used for an AlcoTest™ system*

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HINT

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*An Electronic copy of the User's Manual is available within this submenu*

---

## 5.4 Starting a Measurement

To start a measurement using the currently selected method simply press the green START button as illustrated in figure 5.13 below.



Figure 5.13 – Starting a Measurement

A sample should be introduced into the U-Tube as well as placed onto the prism of the Optics Box Module prior to pressing START. The details of this process are given in section 7 of this manual.

In the event that you wish to test the unit with an AIR sample, meaning an empty U-Tube with only air inside and a clean prism, just press START without introducing any sample.



To STOP a current measurement, press the button.



Figure 5.14 – measuring an obscured alcohol sample

Note: Pressing the STOP button will cause the below dialog to be displayed. The user is prompted to confirm the desire to abort the measurement.

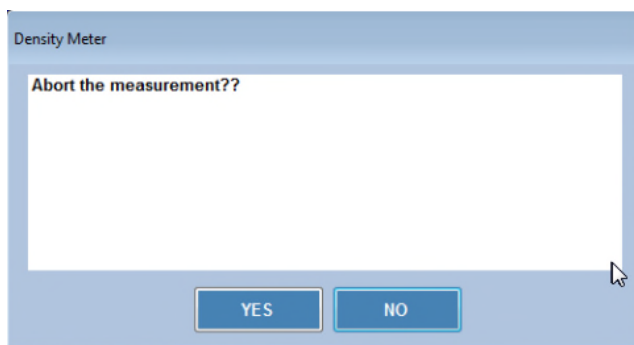


Figure 5.15 – Abort Measurement

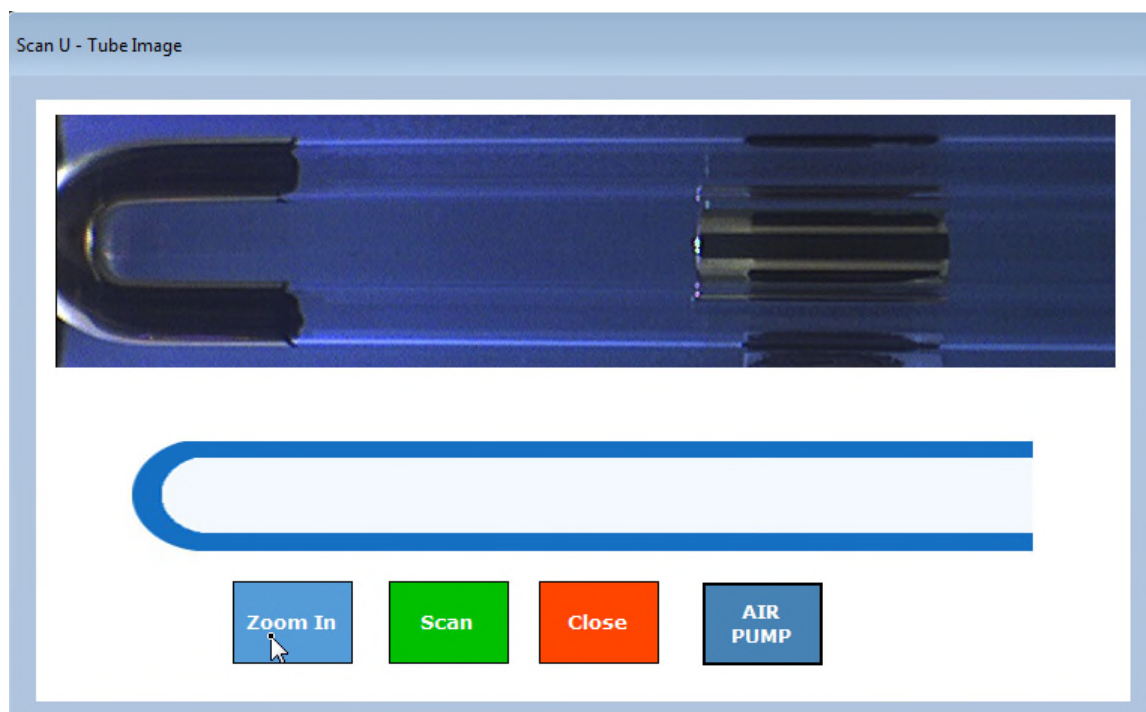


Figure 5.16 – View of U-Tube



The patented VideoView™ feature allows the user to see a real-time video of the Sample Tube, allowing a magnified view. The magnification allows the operator to easily detect the presence of bubbles or incomplete sample filling in the Sample Tube.

Clicking on the image of the U-Tube magnifies the image even further:



*Figure 5.17 – Magnified VideoView™ of AlcoTest™ U-Tube*

Here the user may easily zoom in more and scan the entire length of the U-Tube to ensure that it is properly loaded with a sample and that the tube sample contains no bubbles that will affect the accuracy of the measurement.



## 6. Getting Started: Factory Methods & Their Customization

Rudolph Research Analytical AlcoTest™ is Method driven. This ensures reliability, repeatability and accuracy in measurement for a wide variety of materials. Your AlcoTest™ unit has shipped with a list of pre-configured measurement Methods and custom scales from the factory. These Methods may be used as configured or copied and modified to suit your individual need.

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*Note: Factory Methods may be modified and saved to a new Method. Factory Methods may not be deleted.*

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### 6.1 Selection of a Factory Method

The AlcoTest™ has a list of ten pre-loaded factory methods in the instrument's memory. This allows easy and immediate use for the most common applications. Additionally, there are specialized Methods available for Beer, Beer Tabrie and Wine applications that are not shown. Should any of these specialized Methods be required please contact your Rudolph representative, currently all specialized Methods are only available through protected Factory settings.

Select the Method which is closest to meeting your application. Method selection can be done from the Main Screen by touching the Method button.

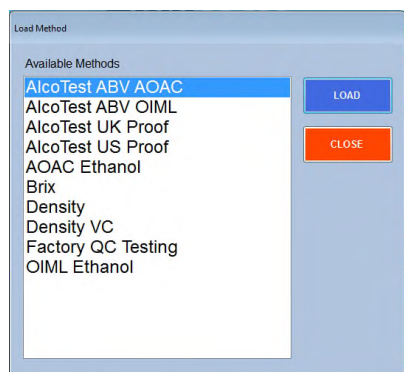


Figure 6.1 – Main Screen – Method Selection

Highlight the Method you wish to use and then touch the “Load” button.

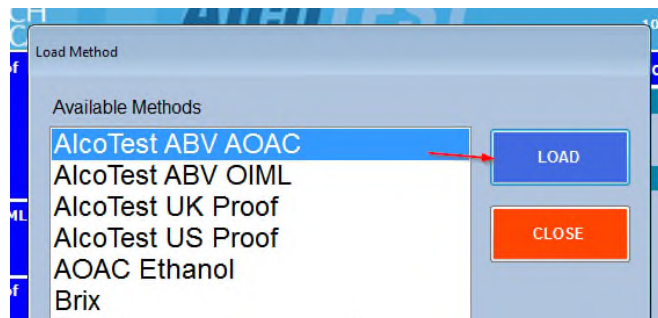


Figure 6.2 – Load Method Screen



HINT

*The default for all the Factory Methods Set Temperature is 20 °C, the Measurement Determination is set to Normal, and the Measurement Mode is Single. An explanation of these settings and how to change them is fully covered in Chapter 6.2 “Customizing a Factory Method”.*

It is possible to Edit and/or Rename the Factory Methods. Below are the default settings and descriptions as shipped:

**AlcoTest ABV AOAC** - Ethanol percentage by volume is calculated using a custom scale that accounts for obscuration that may occur if the sample contains dissolved solids (such as sugars) and other suspensions. Concentration is determined in accordance with the American Organization of Analytical Chemists (AOAC) Tables as percent by volume/volume and as Proof calculated at 60°F but measured at 20°C. The display is configured to show the following: AOAC Ethanol % by vol/vol, Proof, Density, and Specific Gravity at 20°C.

**AlcoTest ABV OIML** – Ethanol percentage by volume is calculated using a custom scale that accounts for obscuration that may occur if the sample contains dissolved solids (such as sugars) and other suspensions. Concentration is derived in accordance with the International Organization of Legal Metrology (OIML) Tables as percent by volume/volume and also as percent weight/weight. The display is configured to show the following: OIML Ethanol % by vol/vol, OIML Ethanol % by wt./wt., Density at 20°C, and Specific Gravity at 20°C.

**AlcoTest UK Proof** – Alcohol Proof is calculated with allowance for obscuration as above and using the formula British Proof = ABV at 20°C x 1.7498  
With the ABV Alcohol by Volume as determined by the OIML table.

**AlcoTest US Proof** – Alcohol Proof is calculated with allowance for obscuration as above and using the formula US Proof = ABV at 60°F x 2.0  
With the ABV Alcohol by Volume as determined by the AOAC table.

**AOAC Ethanol** – Ethanol concentration is determined in accordance with the American Organization of Analytical Chemists (AOAC) Tables as percent by volume/volume and as Proof calculated at 60°F but measured at 20°C. The display is configured to show the following: AOAC Ethanol % by vol/vol, Proof, Density, and Specific Gravity at 20°C.

**Brix** – Displays Brix, Density and Specific Gravity. Brix concentration is based upon NBS Table 113 and is the concentration of sucrose in percent by weight.

**Density** – Displays both Density and Specific Gravity results which have No Correction for the influence of the sample's viscosity.

**Density VC** – Displays both Density and Specific Gravity results which have been Viscosity Corrected for the influence of the sample's viscosity.

**Factory QC Testing** – This is not a user Method but shows the data collected during QC testing at the Factory. See Chapter 13, page 112 for complete details on this Read Only File.

**OIML Ethanol** – Ethanol concentration in accordance with the International Organization of Legal Metrology (OIML) Tables as percent by volume/volume and also as percent weight/weight. The display is configured to show the following: OIML Ethanol % by vol/vol, OIML Ethanol % by wt./wt., Density at 20°C, and Specific Gravity at 20°C.

## 6.2 Customizing a Factory Method

All of the Factory's pre-installed factory Methods may be modified to meet the requirements of the user. To do so, touch the "Menu" button on the AlcoTest™'s main screen.

### 6.2.1 Editing the Measurement Parameters

Depending upon the instrument's current setting, entering the "Menu" may require a password. The factory default password is "123". See Chapter 5, Figures 5.6 and 5.7.

After entering the password, if required, the "Main Menu" will appear.



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*Password may be turned off or edited using the Lab Manager's Password.*

---

There are only 5 choices:

- **Calibration** – For viewing history, doing verification, restoring, and performing an adjustment.
- **Method Management** – From here you may edit, copy, add, and modify existing Methods. Factory Methods cannot be deleted or renamed. These functions are only available for "Custom Methods" made by the end user. However, it is possible to Hide or un-Hide Factory Methods from the menu choices.
- **Operational Parameters** – Communication Settings and all Instrument Configuration is done within this menu option.
- **System Information** - You may View and/or Print the software and firmware versions, the instrument's serial number and Model number.
- **Back to Home** – As the menu suggests, this option takes you backwards to Main Menu

For customizing a Method we therefore would;

Select/Touch the “Method Management” button.

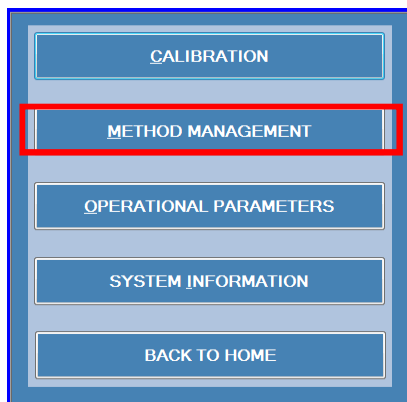


Figure 6.3 – Main Menu – Method Management

Now select/touch to highlight the Method you wish to edit and then select/touch “Edit”. You may also add a new method – see Chapter 6.3.

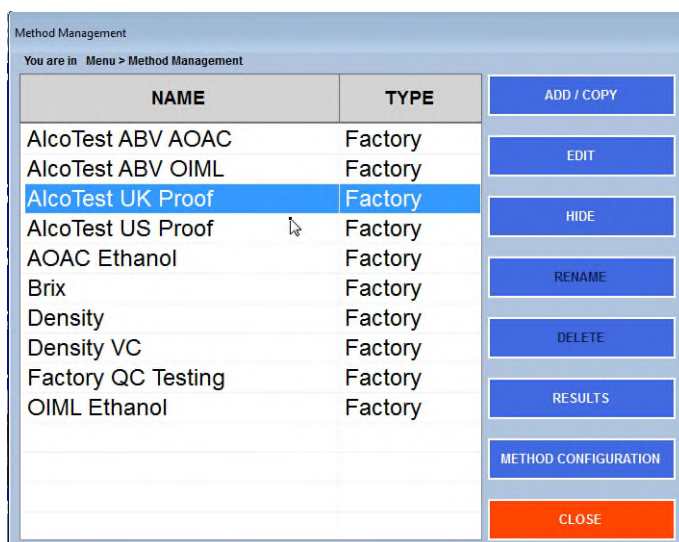


Figure 6.4 – Edit Method Button

After Selecting/Touching “Edit”, the following Window will appear:



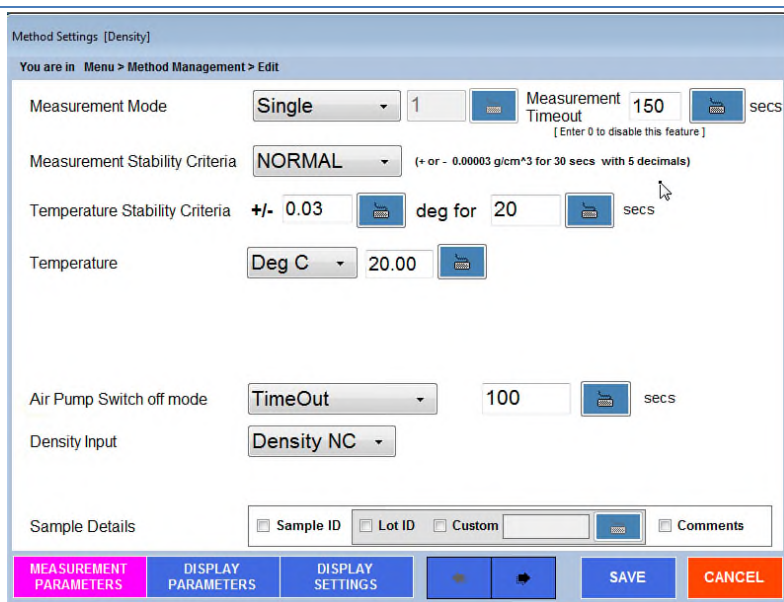


Figure 6.5 – Method Settings – Measurement Parameters

An Explanation of all the options within this “Method Management - Measurement Parameters - Edit” window follows:

**Measurement Mode** – Within this dropdown menu selection there are 2 choices:

- 1) “*Single*” measure mode is where once all the specified measurement conditions or criteria are reached, a density measurement will be made and the display value(s) are now frozen on the display screen until the next measurement is started by selecting/touching the “Start” button. This measurement mode is the factory default.
- 2) “*Multiple*” measurements are where the user may specify any number of measurements (N=X) and that number of measurements will be made and full statistical information for these measurements will be displayed.

**Measurement Stability Criteria** – There are three choices within this dropdown menu that determine when the measurement results are calculated:

- 1) “Full” will provide the user with the maximum accuracy which means that the measurement results will not be calculated until the measurement stability of the sample has met the criteria as defined to the right of this menu selection.
- 2) “Normal” is the optimum setting for the use of the density as per its accuracy specifications. Again, as above, defined to the right of this selection.

- 3) "Rapid" will provide a quicker measurement but with a slight loss of accuracy; accurate now only to the 4<sup>th</sup> decimal place.

**Temperature Stability Criteria** – It is possible to define how stable and for how long the temperature is needed to be prior to making a measurement.

**Temperature** – This is the instrument's "Set" temperature; the temperature that which the sample is controlled to for the measurement. It may be set in either °C or °F. The factory default is °C.

**Air Pump Switch Off Mode** – Here there are 3 choices for the air pump that is used for drying the u-tube after clean with the proper solvent(s):

- 1) **Auto** – The instrument continuously measures the density as the U-tube is drying. Once the dry is that of dry air the pump will automatically turn itself off. See Figure 6.6 in next page for how to set turn off conditions.
- 2) **Manual** – Pump is turned both On and Off manually.
- 3) **Time Out** – This is often the best choice for many applications. The pump will turn itself off after some pre-defined running time. This option ensures that the pump will not be turned on and forgotten and left running for excessively long periods of time. The factory default for Time Out is after 100 seconds. The best drying time depends on what solvent is used and that specific solvent's vapor pressure.

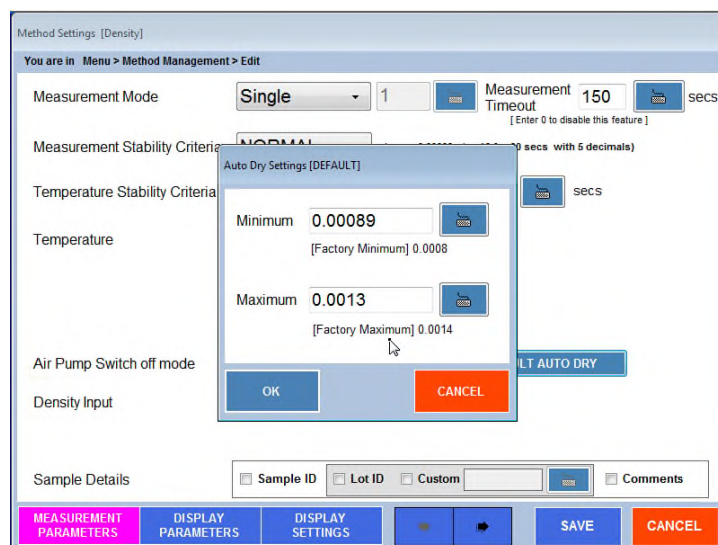


Figure 6.6 – Auto Dry Feature

**Density Input** – if the density results are needed for subsequent calculations this menu option permits the choice of either a density result which was corrected for the viscosity effect (VC) or non-viscosity corrected (NC) density to be used in this calculation. The factory default is “Density NC”.

**Sample Details** – It is always possible to add Sample ID or Lot ID by means of an external keyboard, virtual keyboard in main screen or barcode reader. However, if the lab normally uses sample IDs it is possible to set the AlcoTest™ to remind you to enter Sample ID and/or Lot ID. If you do not wish to use Sample IDs or Lot IDs, unselect those fields as is set by default. The field Lot ID is also able to be changed. You may customize this field to Operator ID or Tank #, etc. Comments may also be added to each measured sample.

### 6.2.2 Editing the Display Parameters

After Editing the Measurement Parameters as explained above in Chapter 6.2.1 it is next possible to edit the display to best meet your requirements.

The left side of the main screen allows up to 5 different measurement results to be displayed. The top position on this display is larger and is used for the value of greatest importance to the user. The four lower positions are slightly smaller and are used for calculated results which are not as important to the user. The values displayed in all 5 of these positions are configurable by the user.



From the menu screen in Figure 6.5, Select/Touch the “Display Parameters” button. Select the Polynomial Group to see the specific calculations regarding Alcohol.

The following window will open:

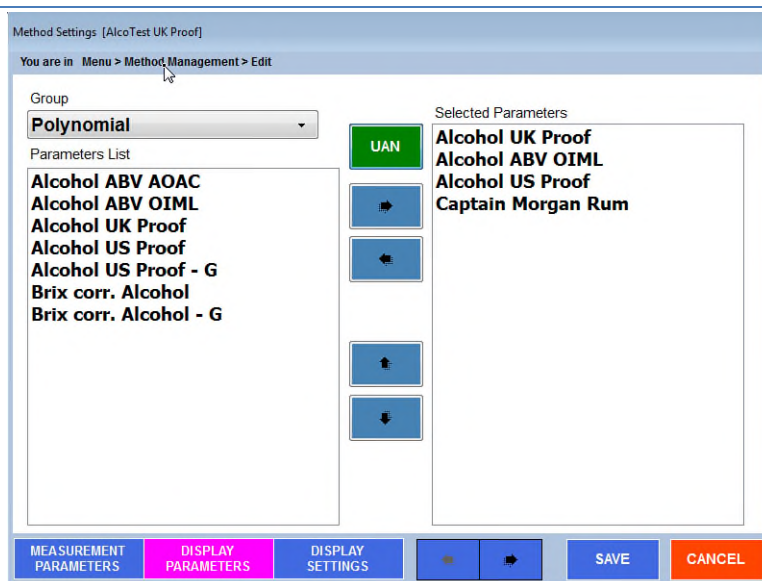


Figure 6.7 – Display Parameters – POLYNOMIAL Group Selected



The keys will move selected parameters onto and off of the displayed list. Remember the TOP selection will be the largest one in the Main Display.



To modify the order of the displayed parameters, use the keys to move a selected display parameter up and down in the list.

As there are many different parameters that are possible to display, these various parameters have been broken into different “Groups” or categories so that they are easier to locate and manage.

## Method Editing

The Available “Groups” are as shown below:

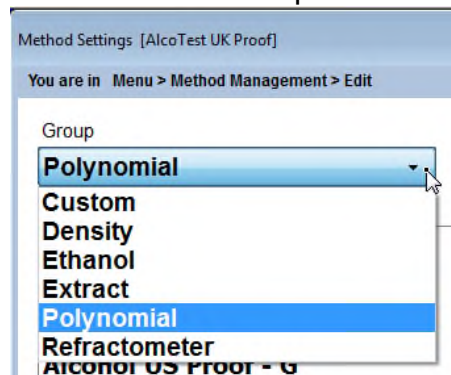


Figure 6.8 – Available Groups

**Polynomial** - The Polynomial Group contains the specialized polynomials that are used by the Alcotest to perform the various types of Alcohol Scale calculations

**Custom** – The Custom Group is where custom offset parameters may be configured to adjust for minor local variations in measured alcohol vs. BDAS alcohol. This group will be explained in a subsequent section on Custom Parameter Configuration.

**Density** –Within this Group List there are seventeen difference choices: Density, Density VC, Specific Gravity, Specific Gravity (t1/t2), Specific Gravity VC, Specific Gravity VC (t1/t2), Relative Density, Relative Density (t1/t2), Relative Density VC, Relative Density VC (t1/t2), Apparent Density Brass, Apparent Density Steel, Apparent Specific Gravity, GB View Density, GB View Density VC, Baume, and Period of Oscillation.



It is possible to select between either Viscosity Corrected or non-corrected as well as defining the temperature of water in the denominator for Specific Gravities and Relative Density calculations. Also, it is possible for both Specific Gravity and Relative Density to define t1 and t2 per  $SG_{t_2}^{t_1}$ . t1 is always the measurement temperature. t2 is set as per display settings within the Method Management’s Display Settings menu.





**Ethanol** – There are 14 different ethanol tables from which to choose. Units include %vol/vol, % wt/wt, and Proof using the AOAC, OIML, HM Customs, NBS, NTS, and the ABNT methods.

**Extract** - °Brix, Plato and Balling are available within the Group.

### Configuring the Display

The first step in configuring your display is to find the various parameters within each “Group” you wish to display. As these parameters are shown in the “Parameter List”, highlight the parameter of interest and then use the  button to move this parameter into the “Selected Parameters” list. Parameters may also be removed for the “Selected Parameters” list by using the  button. You may select up to four different parameters that you wish to display, however, if you select more than the four possible to display parameters then the other additional parameters will be stored and recorded within the “Results”

Once you have selected and placed within the “Selected Parameters” listing other items you wish to display you may arrange the order in which they are displayed. The order in which the parameters are listed in this menu is the same order in which they will be displayed on the main screen. You may change their positions by highlighting the parameter you wish to move and then use the  or  buttons to move that parameter either up or down in this list.

## 6.3 Creating/Adding a New “Custom” Method

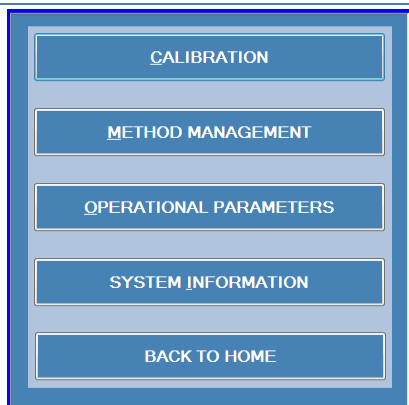
The AlcoTest™ is supplied from the factory with eleven pre-loaded Factory Methods which will meet most users’ requirements. However, the AlcoTest™ permits the addition of as many new methods as needed.

The procedure used to add a new customized method is almost identical to the procedure used above in Chapter 6.2.1 and 6.2.2 to customize an existing method.

### 6.3.1 Adding a New Method

Press or click the “Add” button and once you “Save” the new method you just created, you will be asked to give this new method a name. This new method will now appear in the “Methods” list. These steps are outlined below:

1. Go to the main **Menu**
2. Select Method Management



3. Then select **ADD/COPY** from the menu choices on the right.

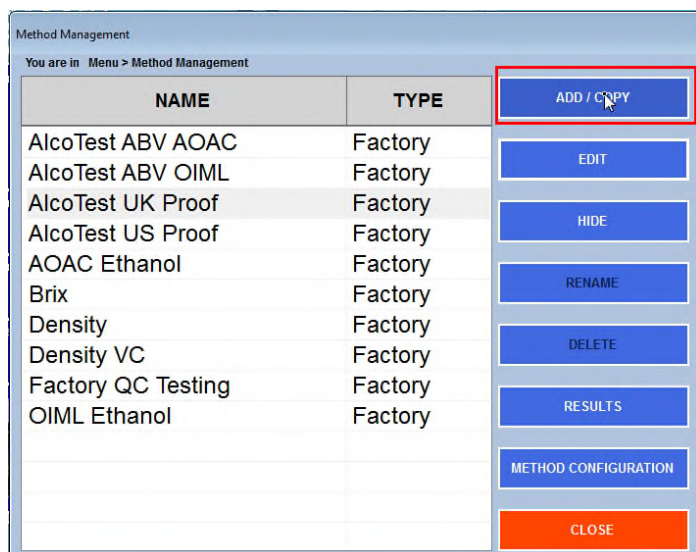


Figure 6.10 – Method Management – ADD a new Method

4. Choose **ADD A New Custom Method**

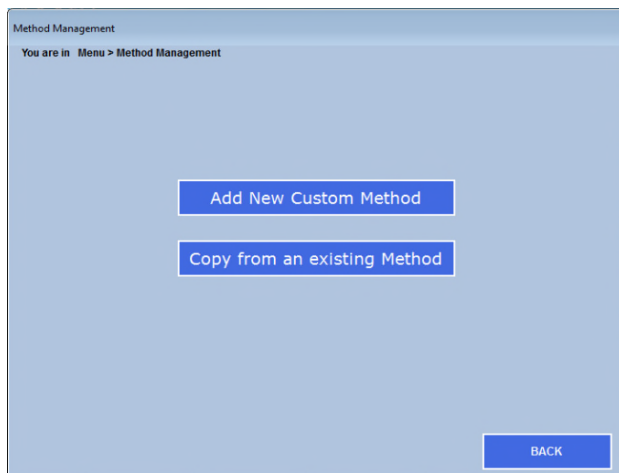



Figure 6.11 – Add new Custom Method

5. A new window opens; Method Settings [New Method] – enter the new Method Name in the space provided. The On-Screen keyboard  is available if needed.

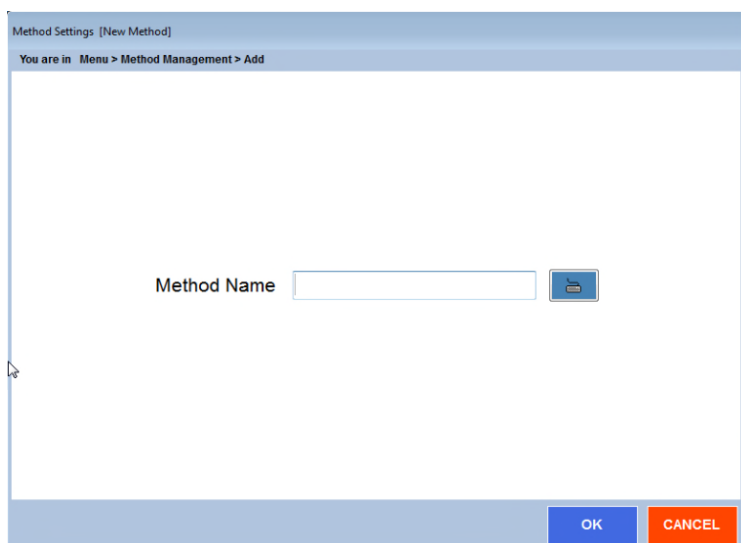


Figure 6.12 – Specify Method Name

6. The “**Measurement Parameters**” dialog will open.

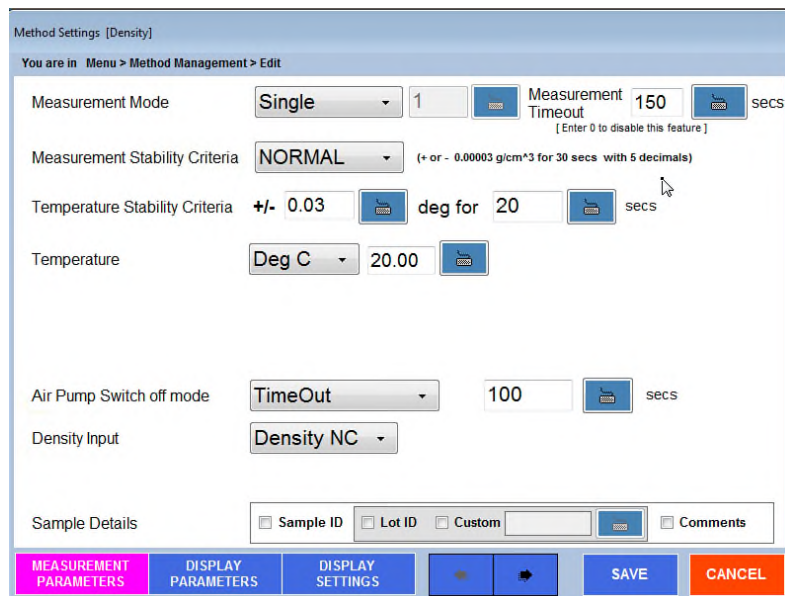




Figure 6.13 – Measurement Parameters screen – Note: does not include optional accessory parameters such as Heated Interface etc.



The new Method parameters may be set as desired; that is, Measurement Mode, Measurement Stability Criteria, Temperature, etc.

7. After setting all the **Measurement Parameters** now select at the bottom of the window, **Display Parameters**. A new window will open and you will see on the top left-hand side a drop-down menu called “**Group**”.

All the different items which may be displayed by the AlcoTest™ are within these Groups. Select the Group of interest and highlight the first item within the Group that you wish to display.

8. Now, with the first display parameters of interest highlighted, press the  arrow to move this parameter over to the right-hand column; “Selected Parameters”. If there are more items within this Group that you wish to display just repeat the process by highlighting that parameter and again using the  arrow to move this parameter over also. Repeat as desired.



Up to four different parameters may be displayed simultaneously.  
You may also, if so desired, use the  arrow or  arrow to move the position of the parameter within the display.

9. Next go to “**Display Settings**”. The dialog window below will open.

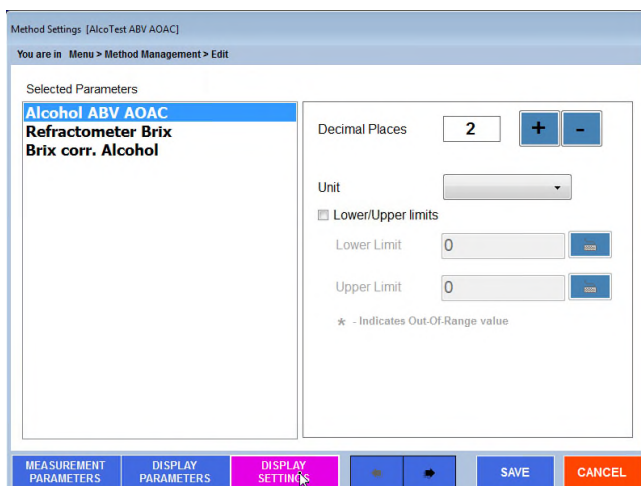



Figure 6.14 – Display Settings – Method ADD

Here you may select the proper number of decimal places to be displayed as well as the units (if applicable) and upper and lower limits. By default the **Print Parameters** and the **Export Parameters** will be the same as the Displayed Parameters.

10. Once you finish with content within this new method you have just created push . Your new Method is ready for use and will be displayed in the available Methods list.



*Note: The new Method is not automatically Loaded. You must LOAD the method using the normal Method dialog as shown in section 6.1 of this manual.*

## 6.4 Customizing the AlcoTest™ AlcoTest™

Customization allows the user to provide information to the system to reflect their specific needs and/or their measurement processes. These customized tables, parameters or polynomials are then used for Concentration determination and display.

- 1) Select **Menu**, then **Operational Parameters**.

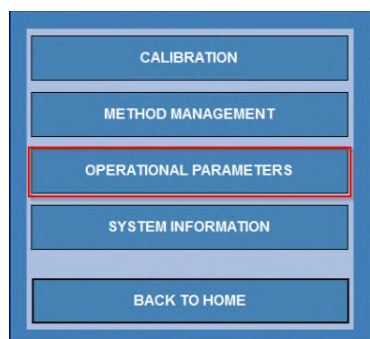


Figure 6.15 – Operational Parameters Menu

- 2) Then select **Instrument Configuration** and then **Concentrations**.

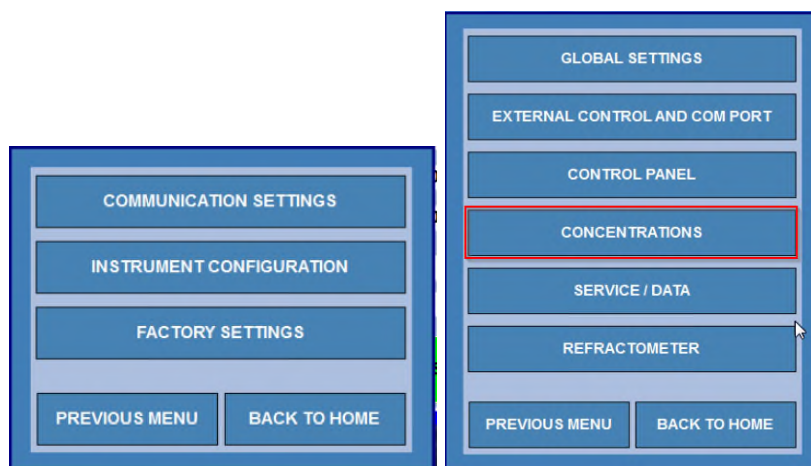


Figure 6.16 – Instrument Configuration -> Concentrations

- 3) After the selection of **Concentrations** you will see the following menu choices:

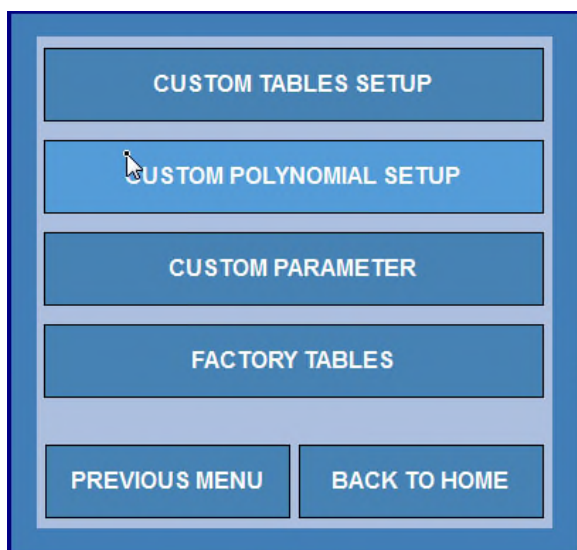


Figure 6.16 – Custom Tables, Custom Parameters & Polynomials Setup Menu

Select **Custom Tables Setup**. The following screen will open:

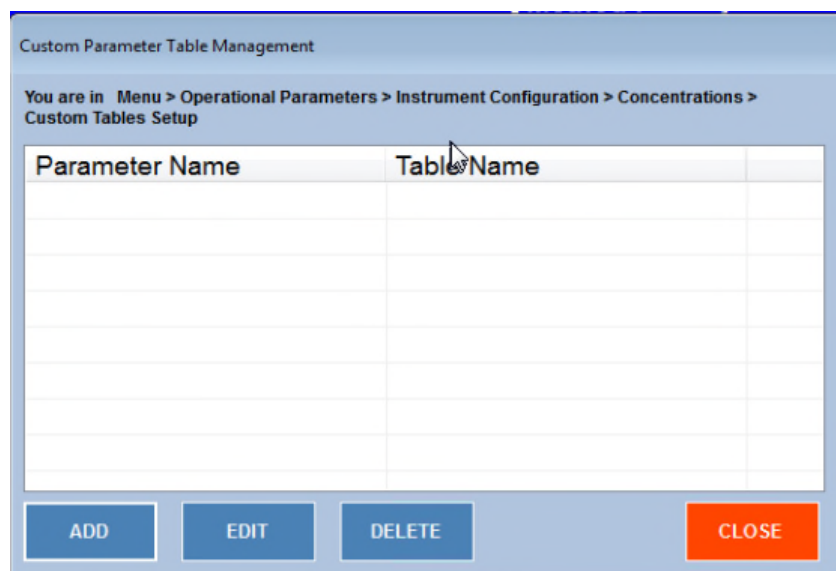
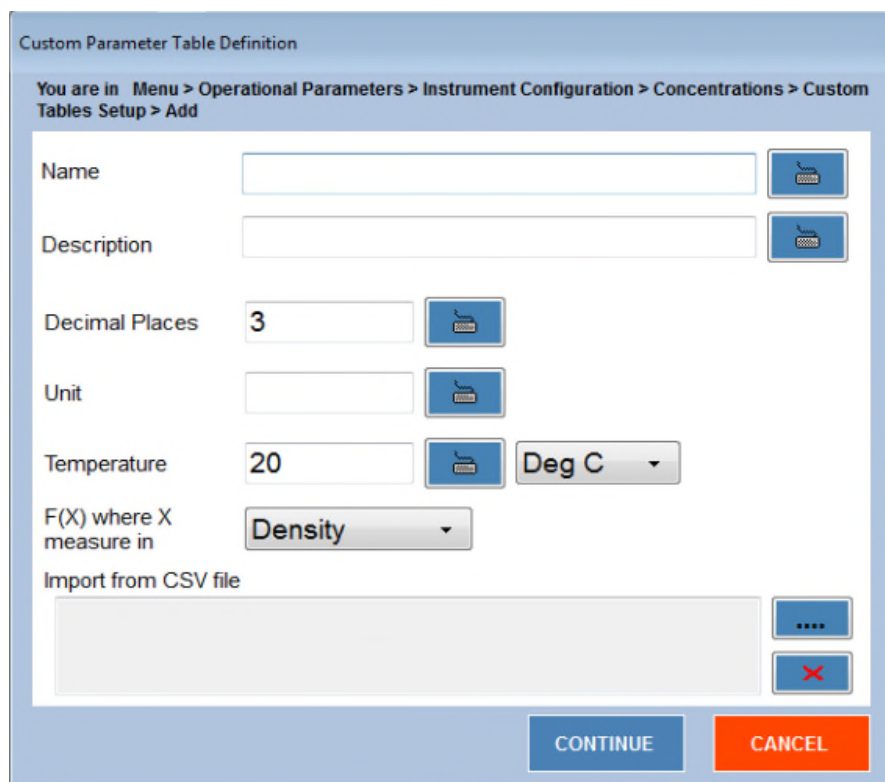


Figure 6.17 – Custom Concentration Tables Setup Dialog

- 4) Select **ADD** to input a new table. The following screen will open:



Custom Parameter Table Definition

You are in Menu > Operational Parameters > Instrument Configuration > Concentrations > Custom Tables Setup > Add

Name

Description

Decimal Places

Unit

Temperature

F(X) where X measure in

Import from CSV file

Figure 6.18 – Custom Tables Setup – ADD Dialog

- 5) Fill out the screen above with a Table name and a Description if desired. Then set how many decimal places is the default for this table. Select the unit and the temperature as well as the temperature units. Select the measured parameter which will be used for the calculation. If a table already exists as an Excel file, please note that you may directly upload that table as a CSV file. See step 7.

6) Select the **CONTINUE** button – the following dialog will be displayed.



The dialog box is titled "Custom Parameter Table Entry". It shows the navigation path: "You are in Menu > Operational Parameters > Communication Settings > Print Settings".

Fields include:

- Name: Custom Table #1
- Unit: g/ml
- Decimals: 3
- Temperature: 20 Deg C
- X as a function of: Density

Below these fields is a table with columns X and Y. To the right of the table are input fields for X and Y, each with a unit selection button. Below these are buttons for UPDATE, RESET, ADD, EDIT, DELETE, and GRAPH. At the bottom are buttons for PRINT, SAVE, and CLOSE.

Figure 6.19 – Print Settings dialog

Click on the **ADD** button and enter the values (X and Y) which reflect the specific values of the parameter you chose (e.g. Density) at the specific concentrations of the sample or solution you are measuring.

Click **ADD** for each entry you wish to place into the table – finish the entry by pressing the **UPDATE** button. If you wish to modify or correct an entry select it and then press **EDIT**. If you wish to cancel or exit from the **ADD** sequence press the **RESET** button.



Once the table is completed you may press the **GRAPH** button to see a visual representation of the table entries. A graph will display showing the points entered.

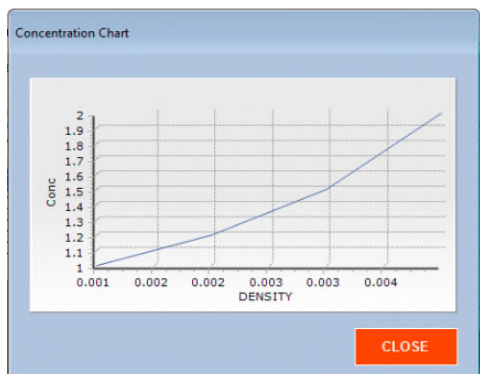



Figure 6.20 – Concentration graph

- 7) Alternately – you may select the  Button. This will display a “browse” window – similar to a Windows Explorer window. You may import a table in CSV format using this dialog.

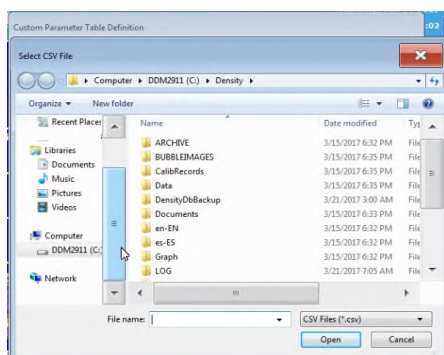


Figure 6.21 – Browse for input data

The format of your CSV file should be - F(x) is the calculated value displayed on the y axis and the input is displayed on the x axis in the CSV table.

Your New Custom Table has now been created and is available for use within the “Custom” Table Group found in Method Management.

### 6.4.1 Editing or Deleting a Custom Concentrations Table

You may also EDIT or DELETE this custom table from the Custom Tables Setup dialog.

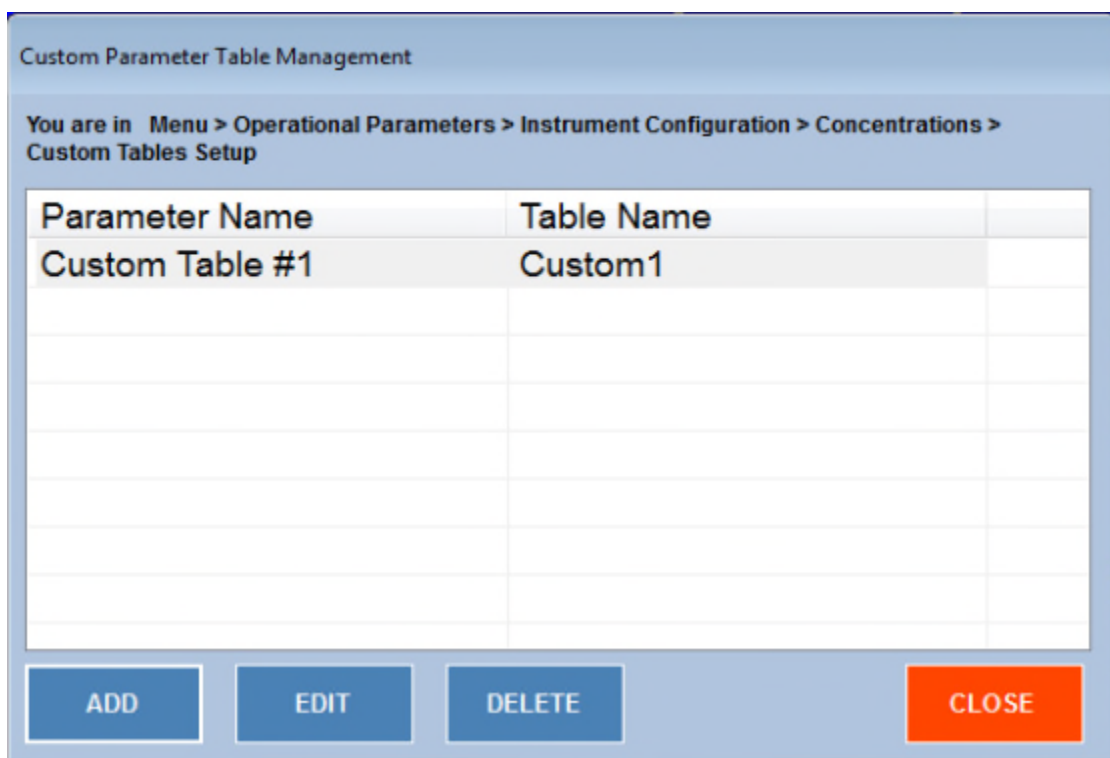


Figure 6.22 – Editing or Deleting a custom Concentration Table

Select the Table to be edited or deleted from the list of custom tables in the dialog. The **EDIT** button brings the user to the same screen as **ADD** and allows the specific information for the selected table to be edited.

The **DELETE** button asks the user to confirm the deletion of the custom table and then upon confirmation removes it from the system database.

## 6.5 Adding a Custom Polynomial into the AlcoTest™

Polynomials may be one dimensional (x,y) using just density or if a refractometer is also in use with density a two dimensional polynomial (x,y,z,) is able to be used.

From the Concentrations submenu select Custom Polynomial Setup.

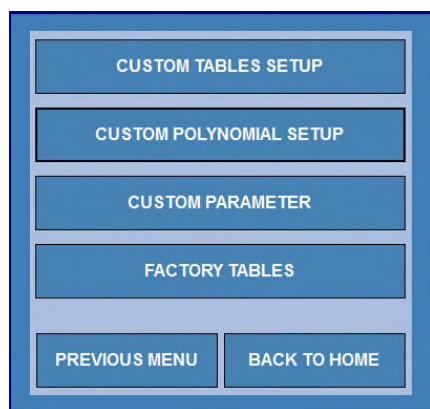


Figure 6.23 – Custom Polynomial Setup

The following dialog will be shown. Note that the AlcoTest™ comes pre-configured from the factory with several custom polynomial tables. These tables have been set up to allow the system to accurately calculate percentage alcohol in obscured liquids or in the presence of dissolved solids like sugars. These polynomials may not be deleted or edited but may be copied and modified if the user wishes to make their own variation of a custom polynomial.

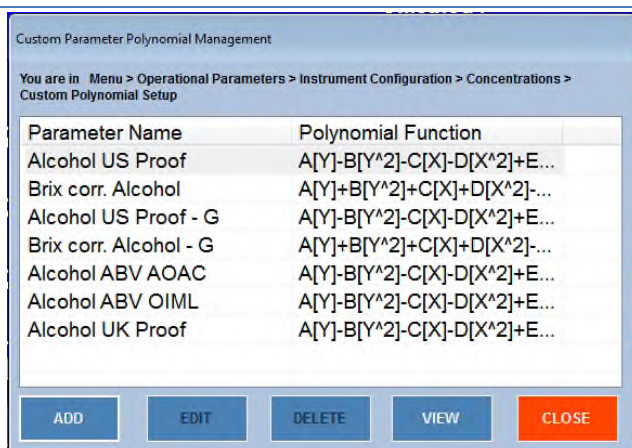


Figure 6.24 – Adding a Custom Polynomial

To make a new polynomial Click on the ADD button.

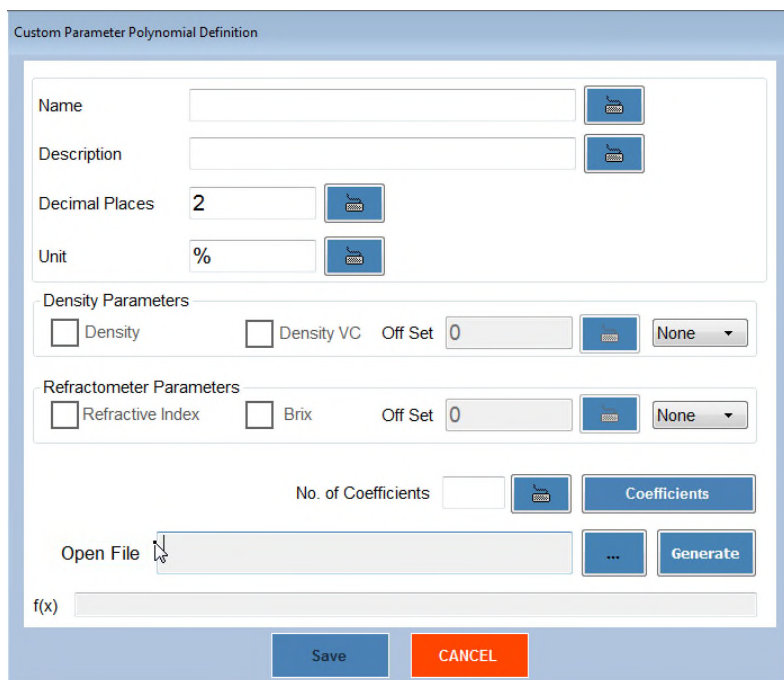


Figure 6.25 – Configuring the Custom Polynomial

Should the end user wish more information regarding the additional of custom one or two-dimensional polynomials please contact Rudolph Research directly for complete details.

## 6.6 Adding a Custom Parameter into the AlcoTest™

The AlcoTest™ allows the user to add Custom Parameters to the system. A Custom Parameter is based on a standard Parameter (such as Alcohol OIML ABV) and gives the user the ability to automatically apply an offset to the calculated polynomial result.

The function of the custom parameter allows the user to adjust the specific parameter to account of additional variations in a specific product. For example if a specific type of rum consistently reports a slightly lower reading using the AlcoTest OIML polynomial the user merely has to enter in the current AlcoTest reading for that parameter and the expected reading. The offset is automatically calculated and applied. In addition, the custom parameter will appear in the Custom Group on the Display Parameters screen – allowing the user to select this parameter when displaying or reporting information.

### *Setting a Custom Parameter*

Open the Concentrations Menu and click the Custom Parameter button.

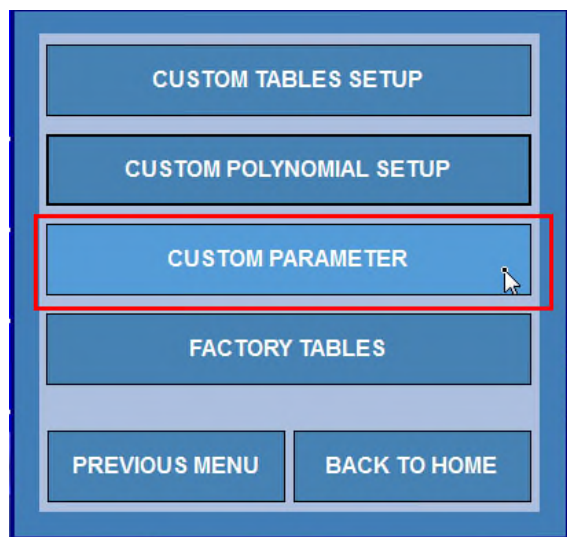
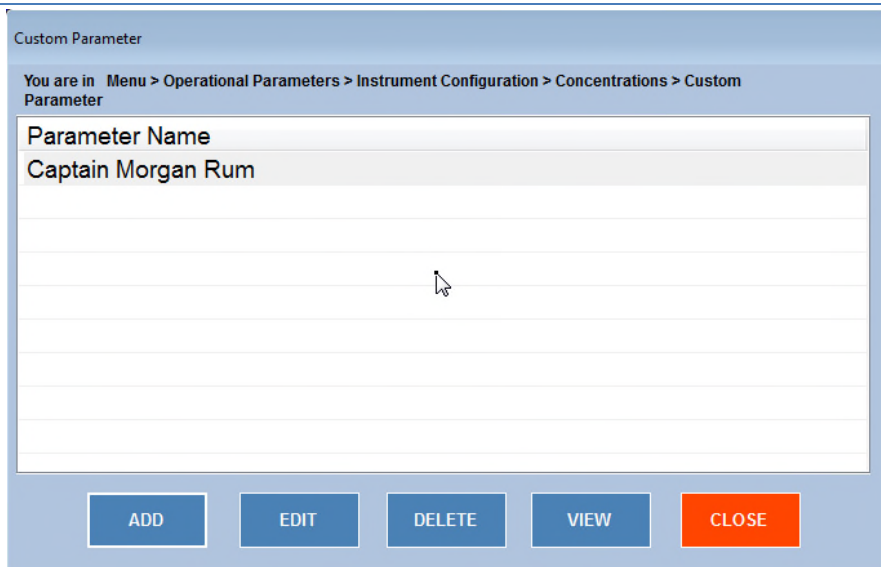


Figure 6.26 – Custom Parameter

The following screen will display:





Custom Parameter

You are in Menu > Operational Parameters > Instrument Configuration > Concentrations > Custom Parameter

Parameter Name

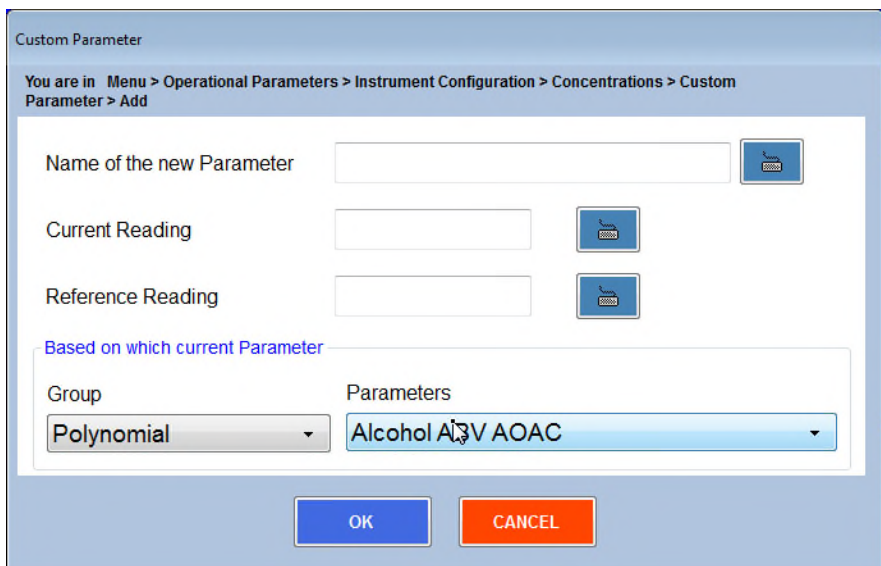
Captain Morgan Rum

ADD EDIT DELETE VIEW CLOSE

Figure 6.27 – Custom Parameter screen

Any custom parameters which have been created will be displayed in this screen – you may also edit, delete or view a custom parameter here.

To ADD a new custom parameter select the ADD button.



Custom Parameter

You are in Menu > Operational Parameters > Instrument Configuration > Concentrations > Custom Parameter > Add

Name of the new Parameter

Current Reading

Reference Reading

Based on which current Parameter

Group Parameters

Polynomial Alcohol AOAC

OK CANCEL

Figure 6.28 – Adding a Custom Parameter

The Custom Parameter name should be filled in as well as the current (calculated) reading and the expected or reference reading. The Group that the custom parameter is based on may be selected in the Group dropdown box. Last the specific parameter that will be offset in the custom parameter must be chosen.

Click Save to save the new Custom Parameter. It will now appear as a choice in the Display Parameters Custom group as shown below.

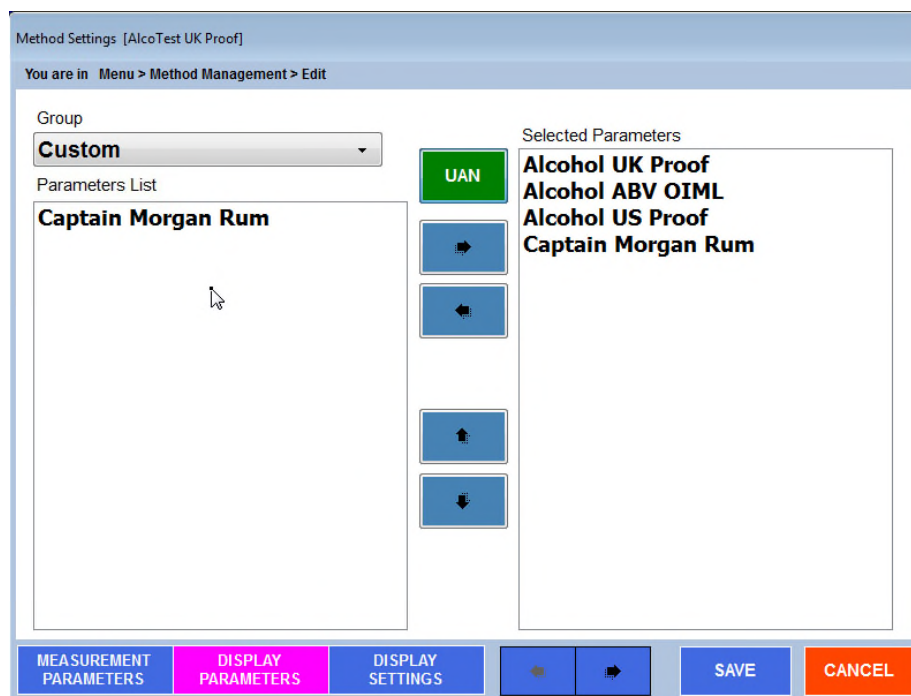


Figure 6.29 – Display Parameters selection of a Custom Parameter from the Custom Group

## 7. Measurements – Manual Injections Using a Syringe

This Chapter only deals with the measurements made in a manual mode using a syringe. Automation is considered separately in Chapter 12.

### 7.1 Method and Measurement Conditions

Select the desired Method to be used for the measurement using the “**Method**” button on the bottom of the display screen. After pushing this button, the list of possible Methods will be shown in Figure 6.2



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*The measurement conditions, such as, temperature, items displayed, results printed and/or saved, etc. are all defined and set within each Method. See Chapter 6 for complete details for changing and customizing all the various Method settings.*

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After this selection, the AlcoTest™ will configure itself to all the proper settings as defined by that Method.

### 7.2 Manual Measurement Using a Syringe

Check to be sure that the glass sample U-tube and the filling nozzles are empty, clean and dry. You may use the VideoView™ for visual confirmation, but it is also useful to look at the density value measured for this empty U-tube. If the U-tube is completely empty, clean, and dry the measurement value should be that of air.

The measured value for clean, dry air is normally 0.0012 g/cm<sup>3</sup> at 20.00 °C and 25.00 °C. Slight variations of one or two counts in the fourth decimal place are possible due to changes in barometric pressure and/or relative humidity. However, if the air density is seen to be greater than 0.0013 g/cm<sup>3</sup>, (or whatever value prior experience has shown), please clean and dry the U-tube prior to continuing with this measurement.

See Chapter 8 for complete details for proper cleaning and drying of the sample U-tube.

*NOTE: The wetted materials during a sample measurement are the borosilicate glass U-tube, and the filling nozzles assemble (Teflon-PTFE and Halar-ECTFE), the polypropylene hose barbed adapter, and the connecting Silicone tubing which leads to the waste container.*



*Please be sure that the sample materials being measured and the solvents used in cleaning and drying of the U-tube after a measurement are compatible with these materials.*

Sample ID and/or Sample Lot numbers may be optionally entered at this time. Use the “Sample ID” and/or the “Lot ID” buttons on the main screen. Once pushed, a keyboard will appear as below.

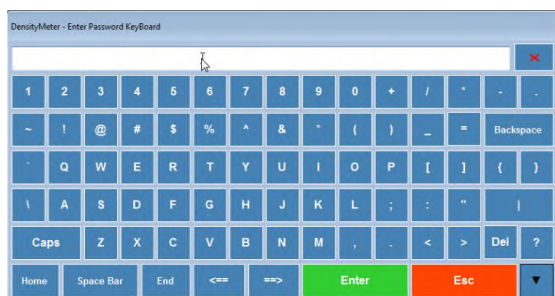


Figure 7.1 – Touch Panel On-Screen Keypad

## Loading the U-Tube

Carefully fill a syringe with the sample to be measured. Inject the sample carefully into the front filling nozzle. The back nozzle uses a drain line that leads the used sample and rinse solutions into a waste container.

While filling the sample with the syringe, it is very important to use the VideoView™ feature to ensure that no bubbles are present in the sample. Bubbles, even very small ones can cause measurable errors.

Press or click the image of the U-Tube on the display screen.



Figure 7.2 – U-Tube Display

The U-Tube scan dialog will be displayed.



Figure 7.3 – U-Tube Scan


The user may scan any part of the U-Tube at magnification if desired. Pressing or clicking on the blue graphic of the tube will move the camera to that specific part of the U-Tube Image.

Then watch as you are filling the glass U-tube. If you see a bubble go into the glass cell, continue push in more sample until you see that same bubble leave



the cell. Leave the syringe in place to avoid leakage or siphoning of the sample back out of the U-tube.

The AlcoTest™ also has the ability to pan/scan for bubbles in the sample.

Pressing or clicking the  button will initiate the auto scan / pan of the U-Tube image. The user can easily see if there are any bubbles in the magnified scan as it passes thru the view window.

The AlcoTest™ has three different modes for making a measurement. Two of these modes, **Single** measurement and **Multiple** measurement are available within most all Methods. The third mode, **Continuous** measurement has a method all its own.

### **Loading the OBM**

Next a portion of the sample must be placed on the prism stage of the Optics Box Module. It is important that the prism be clean and dry prior to placing the sample.

Lift the Presser Head and clean the prism. If there is any leftover sample or residue be sure to use an appropriate solvent such as distilled water or acetone. Once the prism is clean wipe it carefully and allow it to dry thoroughly

Now place a small amount of sample onto the prism.

For all measurements, it is important to load the sample to be measured in the proper way. See below for an example of a correctly applied sample. Place the sample on the prism of the instrument as shown below:



*Figure 7.4 – Placing a sample on the Prism*



*Figure 7.5 – Sample Clean Prism      Sample not correctly applied      Sample Correctly applied*

Methods can be configured such that they will automatically examine the quality of the sample applied and block measurement if the Sample Quality does not exceed a predetermined amount. When the sample is loaded the Live Reading display should change accordingly.

After the sample has been successfully injected into the U-tube without any bubbles, and the prism of the OBM is loaded as above, push the “Start” button to start the measurement process.

After the measurement has been made and the results obtained, clean and dry the U-tube and the OBM prism with suitable solvents.

For the U-Tube often this cleaning requires two different solvent rinses. The first rinse is a solvent in which the sample itself is soluble. Push this rinse 1 solvent

through the AlcoTest™'s U-tube using either a syringe or a rinse solvent bottle. Rinse #2 is often used as a solvent which will push out and replace any residue of rinse #1 and also dries completely and quickly. Acetone is often used as rinse #2 for this purpose.

Use the built-in air pump for drying out this solvent. In the “**Method Management**”, “**Measurement Parameters**” menu it is possible to set the air pump to turn itself off automatically in a predetermined amount of time. Normally, 1 to 2 minutes of drying time is adequate for the drying of acetone. If an alcohol is used as the drying solvent rinse #2, then it may be necessary to increase the drying time to 2 to 3 minutes.

Pressing the U-Tube Image will allow the user to make a magnified inspection to ensure the tube is empty and clean. In addition, the Air Pump may be activated from this screen to assist in drying or solvent removal.

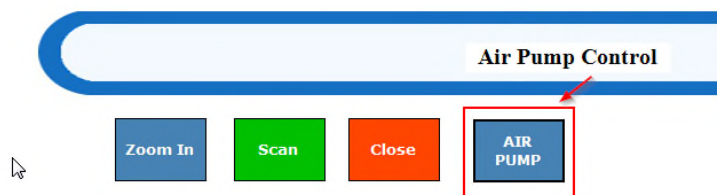


Figure 7.6 – Air Pump Control

After the AlcoTest™ is clean and dry it is now possible and recommended to make a measurement on air to see if this cleaning and drying was done properly. If the Measurement Mode is set to either **Single** or **Multiple**, the air density measurement can be started after the cleaning and drying process by pushing the Start button.

## 7.4 Measurement Result Management

There is great flexibility and many options available to the user for the management, printing, saving and exporting of measurement results.

### 7.4.1 Printing

Any Windows compatible printer may be used to printout the results. The printer may be connected directly to the AlcoTest™ via a USB cable or it may be configured to use a Networked printer. If it is found that the printer is not plug-and-play compatible it is possible to load a specific printer driver onto the AlcoTest™ to support that printer.

Sample results may be printed out as required with the use of the “**Print**” Button or if the Method is so configured; printing will be automatic after each measurement is made.

Windows Embedded supports over two hundred different commonly used printers. This includes printers manufactured by Hewlett Packard, Epson and Lexmark. The software will, within a minute or two, recognize the printer which will then appear within your Devices and Printers in the Windows Control Panel. See Appendix D for a list of printers supported by Windows.

You may access the Windows Control Panel as follows:  
Press **Menu > Operational Parameters**

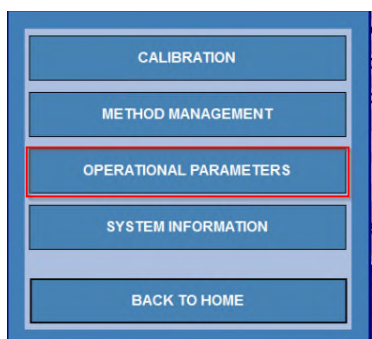


Figure 7.7 – Operational Parameters Menu

Now Press or click **Instrument Configuration** and then **Control Panel** and then **Windows Control Panel**

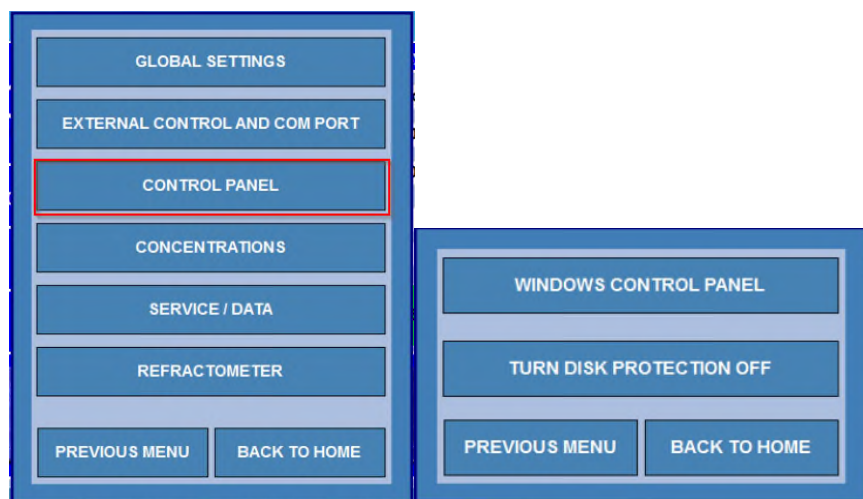


Figure 7.8 – Accessing the Windows 7 Embedded Control Panel

If you double click on “Devices and Printers” the following screen will appear:

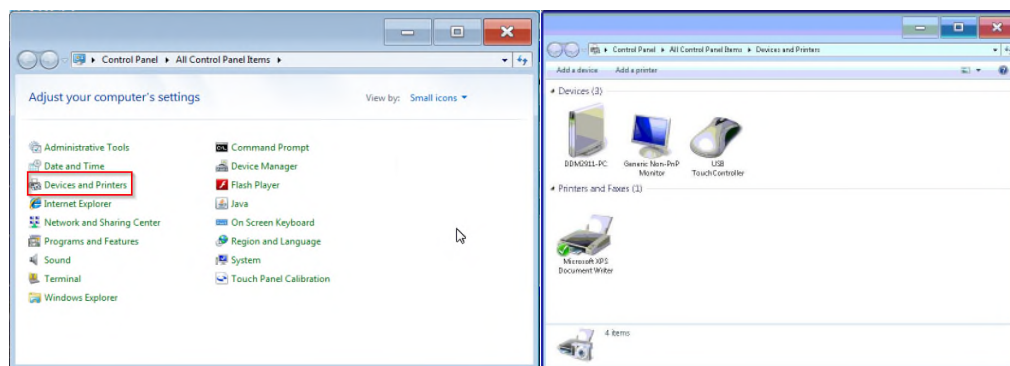


Figure 7.9 – Windows Control Panel - Devices and Printers

Select your printer from the displayed devices. There are options to configure the AlcoTest™ to a non-local printer or a printer which requires customized device drivers.

If required, other drivers may be installed just as would be done with any PC. Much more detailed information is provided in Chapter 10 for loading printer drivers.



The selection of what measured parameters are to be printed is within Method Management. To customize the printed report for a specific Method go to: **Menu > Method Management**

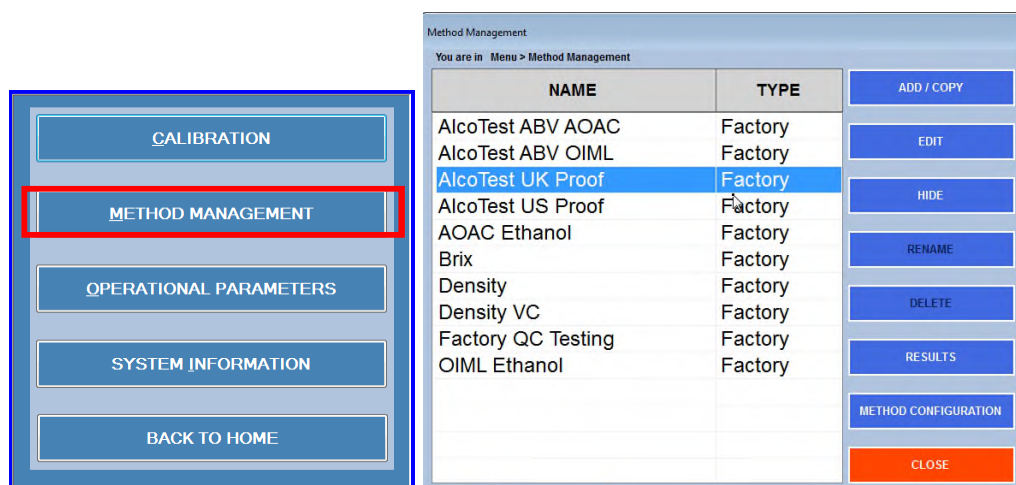


Figure 7.10 – Selecting the Method to Edit

Then highlight the Method where you wish to define what measured parameters are printed. Then select “**Edit**”. The menu will now open as shown in Figure 6.5

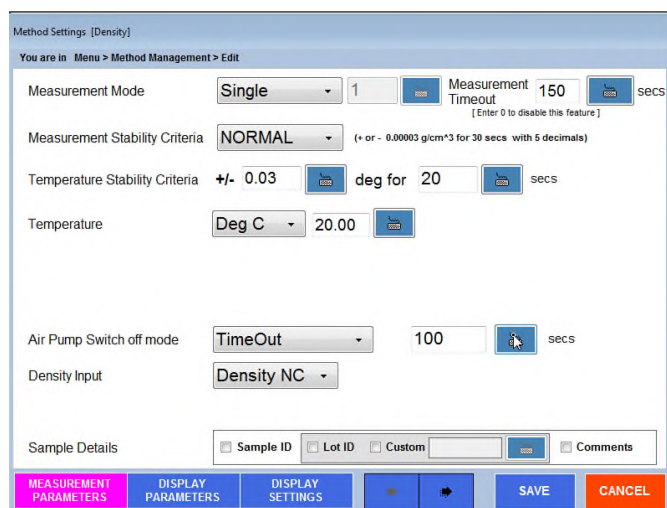



Figure 7.11 – configuring the Print Parameters

If you now select the  button you will see the parameters which have been set by default to print in Print Parameters Tab.

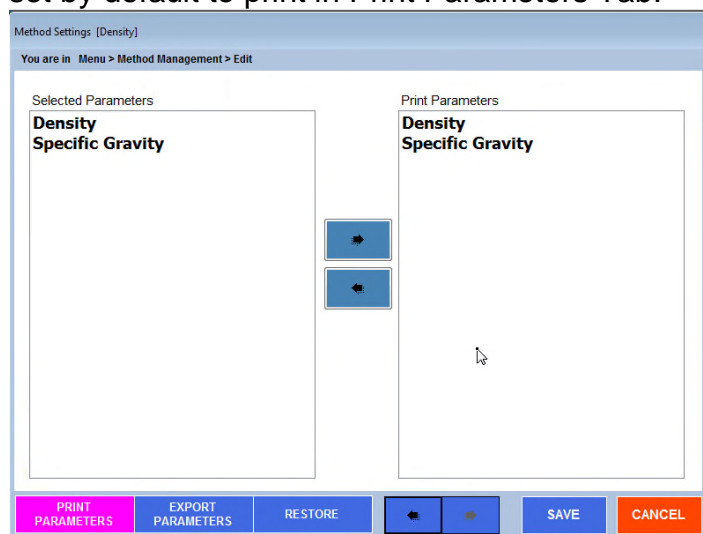


Figure 7.12 – Choosing the Print Parameters

From this dialog it is possible to select or deselect what measured parameters will be printed. By default, the same parameters which are on the main screen's display are set to be printed.

The same holds true for Exported measured parameters which will be discussed later.

## 7.4.2 Printer Results Selection

Besides selecting which printer you wish to use it is also possible to set when the results will be printed and if you desire to add your companies' logo onto the printout. See Figures 7.13 and 7.14.

Go to: **Menu > Operational Parameters > Communication Settings**. The following submenu will open:

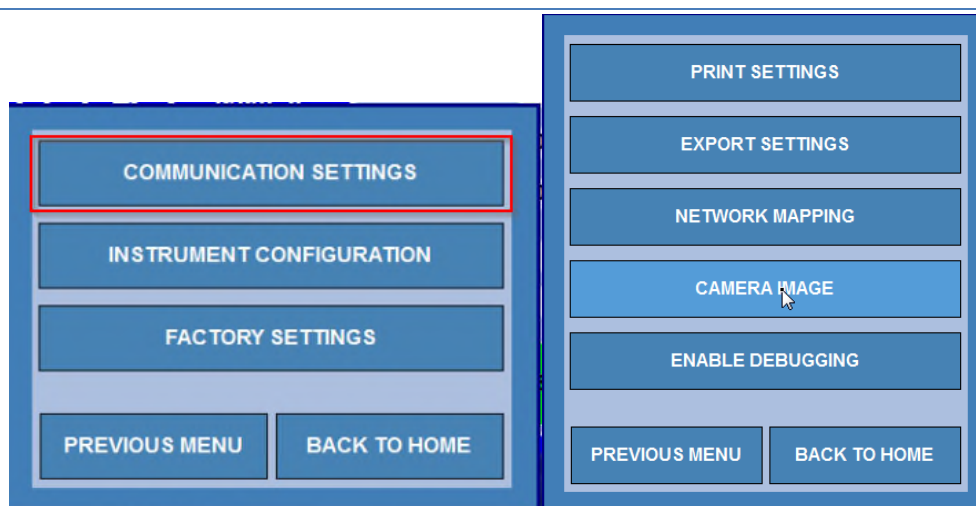


Figure 7.13 – Communications Settings Menu

This submenu allows your access into both Print Settings and Export Settings as discussed in the next section 7.4.2.

Select “**Print Settings**” and the following menu opens as shown in Figure 7.14



Figure 7.14 – Print Settings



Your company logo may be added to the print output. Select the button and the following dialog will appear. Standard graphics format files – such as a PNG file, are acceptable for logos.

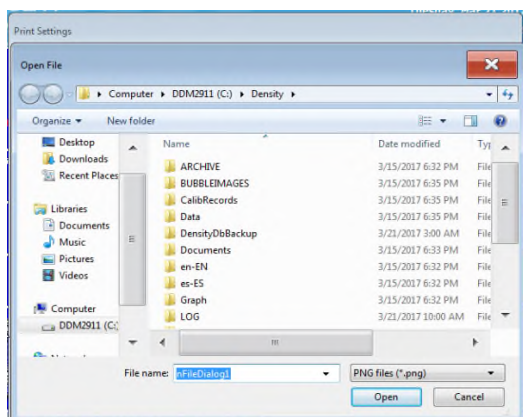


Figure 7.15 – Browse for logo

The FOOTER configuration screen allows the specifics of the output footer to be modified.

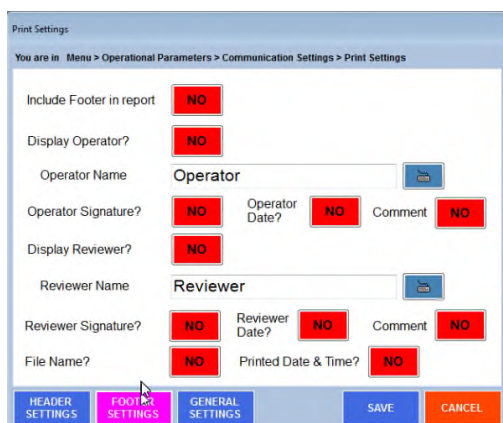


Figure 7.16 – Footer settings

In addition, the user may configure the General Settings. In this dialog the user may select the printout to be automatically produced at the end of each measurement.

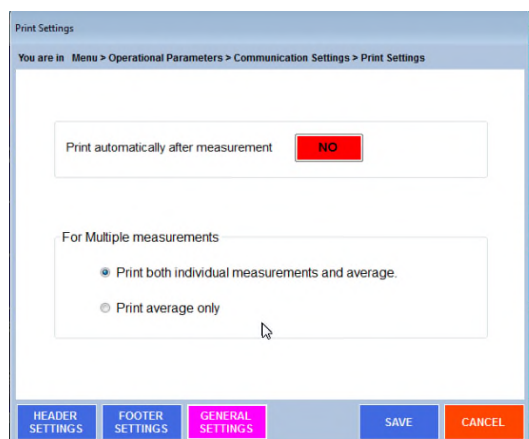



Figure 7.17 – General settings

### 7.4.3 Exporting

The selection of what measured parameters are exported is done exactly the same as the selection of printed parameters as explained above in section 7.4.1.

From the **Method Management > Edit** screen, select **Export Parameters** by

clicking on the right arrow  on the bottom of the screen and then selecting Export Parameters.

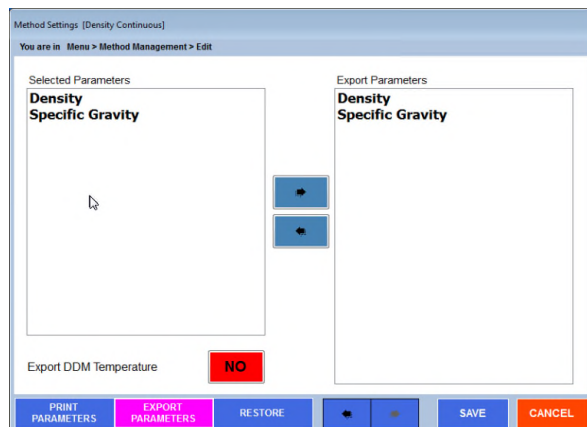


Figure 7.18 – Export Parameters



#### 7.4.4 – Detailed Export Settings

To further define the items exported you must use the “**Export Settings**” submenu as in figure 7.18 above.

Select **Menu > Operational Parameters > Communication Settings**. Select **Export Settings** - The following submenu will open:

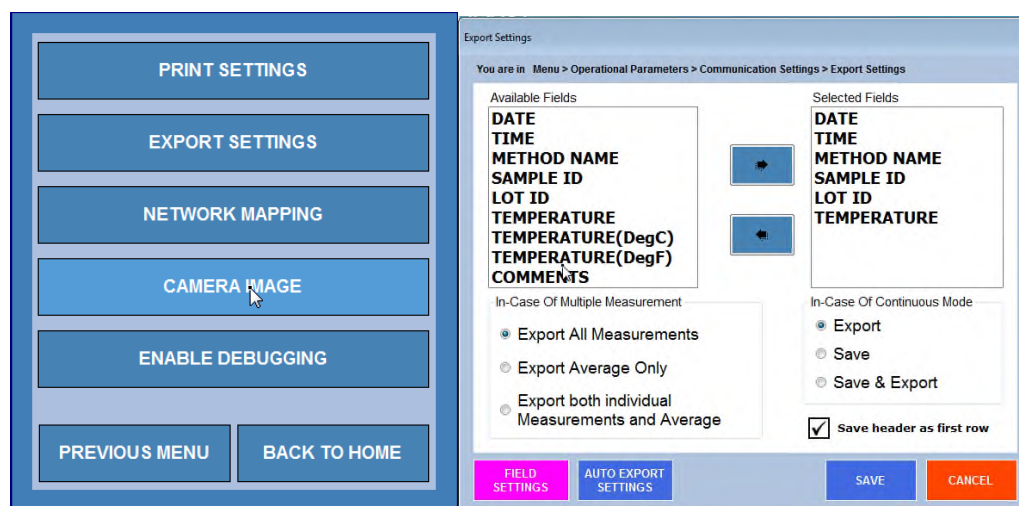


Figure 7.19 – Export Settings

From the screen shown in Figure 7.6 it is possible to define where to export the data and what file name should be used. To do so, select the Blue Button, “**AUTO EXPORT SETTINGS**”. When you do so, the following menu screen will appear:

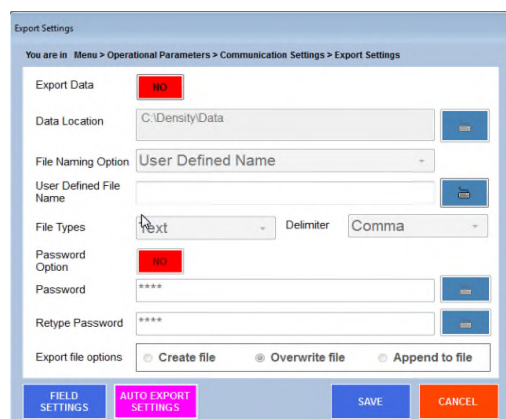



Figure 7.20 – Auto Export Settings Dialog

To set the location where files will be exported select the  button. Selecting the Browse Button will open the following dialog which is similar to a Windows Explorer dialog. You may select from the displayed folders to choose the location where the Data will be exported to.

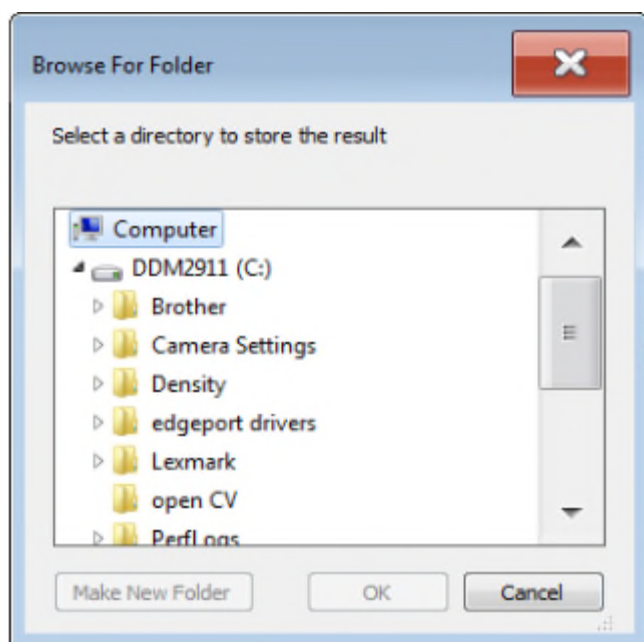


Figure 7.21 – Choosing a location for the Exported Data file.

Data may be saved/exported to any desired location, this is, a second PC, a server, etc. Just define the path. If a flash Drive (thumb drive) is inserted into one of the USB ports the AlcoTest™ will recognize this USB device and offer it as an option for export location.

### 7.4.5 Saving Results

Measurement Results are automatically saved locally.

To review these saved results use the Result button on the bottom of the Main Screen. It is also possible to get to Results via Method Management. Select **Menu > Method Management**. Then, Highlight the Method and press Results

By default the result for today's date are immediately available; however, any date range may be selected.

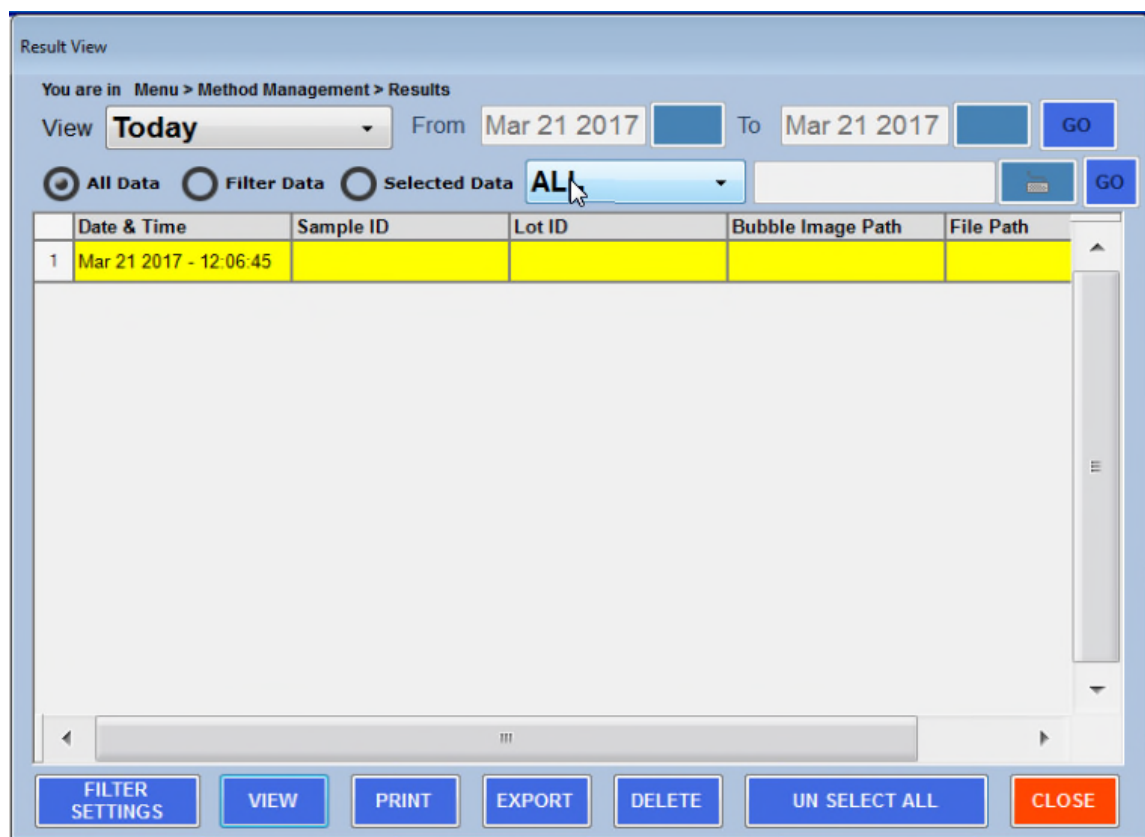


Figure 7.22 – Previous Stored Results Window

By making use of the **VIEW** button the user can see a selected result in detail.

The **PRINT** button will send the selected result or result range to the configured printer.

The **EXPORT** button will export the selected results to the export file location.

The **DELETE** button is password protected. If 21CFR11 is enabled it is not possible at all to delete Results.

The **Un Select All** button will cancel the current selection.

The **Filter Settings** Button will bring up the below dialog.

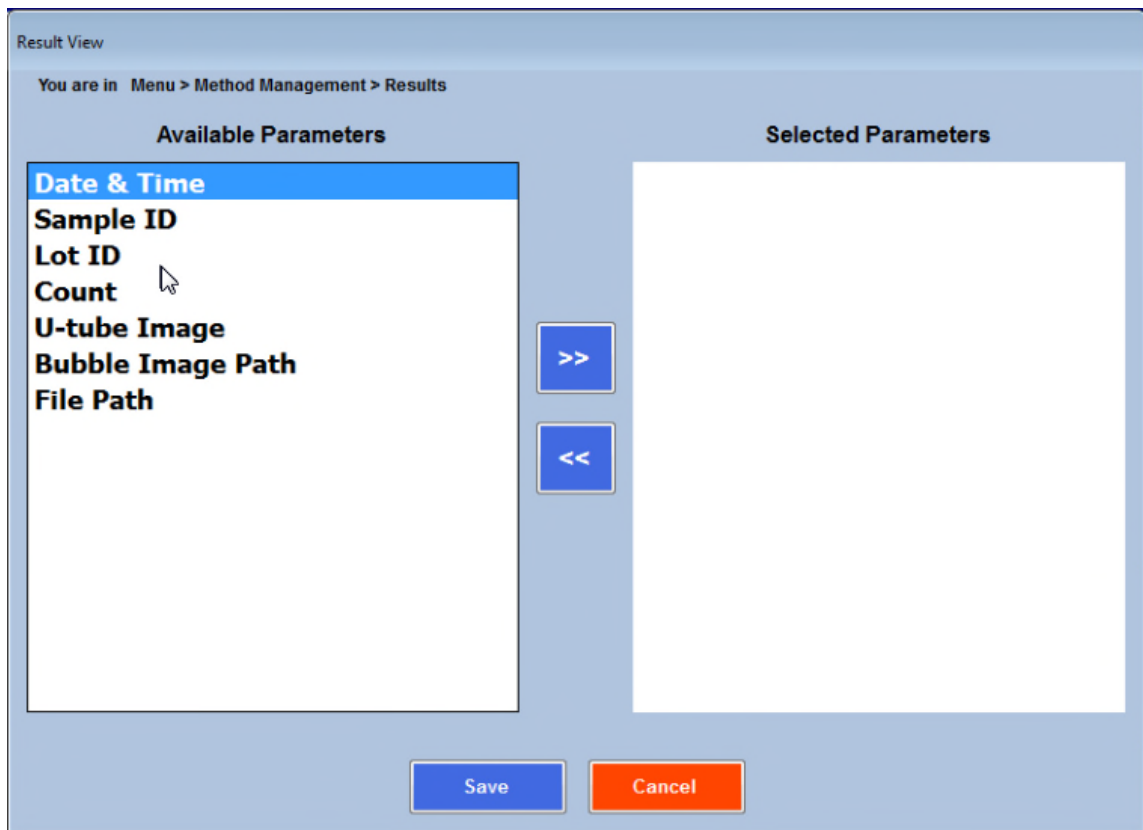


Figure 7.23 – Filter Settings

Each parameter can be selected and added to the Filter Settings List. This will then provide the user with a way to cull the results and only display those results that match the filter.

Once a filter setting or settings have been chosen the user can select the Filter Data radio Button.

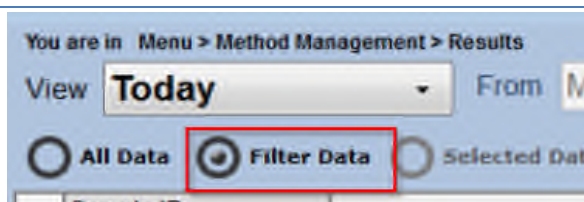


Figure 7.24 - Filter by Date

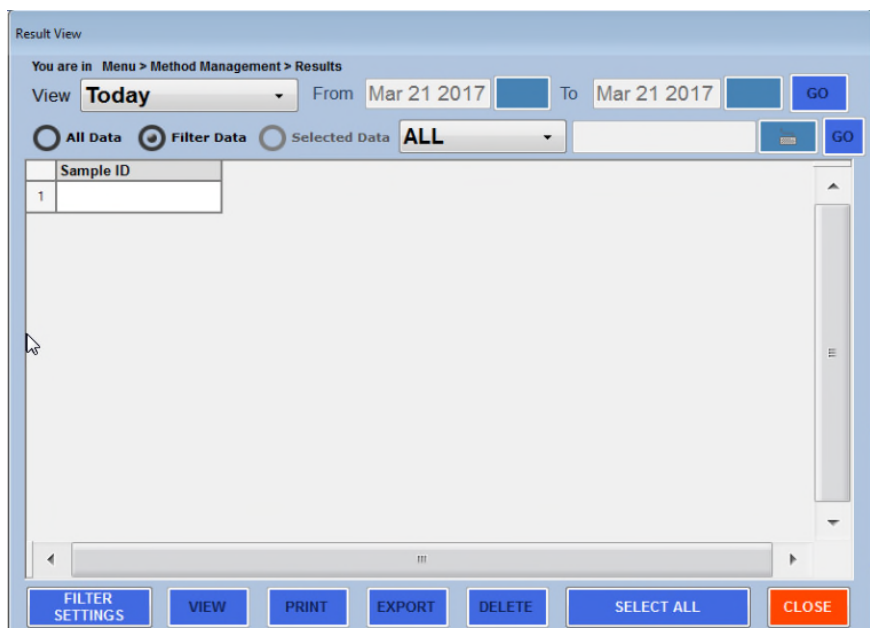


Figure 7.25 – Filter results output display

The selected filtered fields are displayed.



## 8. Cleaning and Drying the Sample U-Tube

### 8.1 Routine Cleaning in-between samples

In general, it is best to rinse, clean, and dry the U-tube after each and every measurement. This process is best done with two different rinsing solvents. The first rinse is selected as the best solvent for the sample material. If the sample is an aqueous solution, then water is often the best choice as rinse #1.

Then this rinse #1, water could next be cleaned out best with the rinse #2 which could be some solvent, like acetone, which dries quickly. The rinsing with solvents may be done using either a syringe or using solvent rinse bottles.



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*The chemistry of the sample determines the selection of the rinse solvent. A general rule of thumb is polar dissolves polar and non-polar dissolves non-polar. The end user must be responsible for appropriate selection of these rinse solvents. Special hazards of your samples may be only known to user. For example, you would not wish to rinse out concentrated sulfuric acid using water due to the resulting violent exothermic reaction that could cause splattering of sulfuric acid and possible exploding and **damage to the glass U-tube**. Always have an understanding of the chemistry of the samples being measured.*

---

The general steps to proper cleaning and drying are as follows:

1. Use a well selected rinse solvent #1, push out the sample to the waste container and wash the U-tube using this solvent. Either a Luer tip syringe or a solvent rinse bottle may be used but the advantage to a syringe is it is possible to push and pull the solvent back and forth using it. Pulling back and forth on the plunger of the syringe with the solvent does a very good job at “scrubbing” of the U-tube and uses less solvent than the same cleaning done with a solvent wash bottle. It may be necessary to repeat this rinsing with a second syringe full of rinse solvent #1.

2. If Rinse Solvent #1 is not a solvent which dries quickly or dries without residues, then rinse it out with solvent that does dry quickly and without residues. Often reagent grade acetone or an alcohol is used in this step. If both solvents are available, acetone is preferred as it dries quicker than all alcohols.
3. The AlcoTest™ has a built-in drying air pump. Use this pump to push out Rinse Solvent #2 and to completely dry the U-tube. It has available the option of a timer which will automatically turn it off after a set predetermined amount of time. See Chapter 6.2.1 under the heading, "Air Pump Switch Mode". Normally 2-3 minutes of drying time is sufficient.
4. Once the U-tube is completely dry, it is possible to confirm complete cleaning and drying by making a measurement of air. If the U-tube is completely clean and dry, the measurement results should be that of clean dry air. For complete data on what the density should be for clean, dry air see Appendix D. In most cases, at 20° C and at one atmosphere, the density of air should be 0.0012 g/cm<sup>3</sup>. If the air measurement results are more than one or two counts high in the 4<sup>th</sup> decimal place, there is good reason to believe that the cleaning and/or drying process was not adequate. It would be suggested to clean and dry the U-tube again.



HINT

**TIPS:**

- If the Rinse Solvent #1 is a solvent which both dissolves the sample and also dries quickly, this is the only solvent required.
- In addition to the use of a Luer tip syringe for his cleaning as described above, the same cleaning may be accomplished by use of a peristaltic pump or gravity fed system.
- Be sure there is no chemical reaction between the sample and Rinse Solvent #1
- Be sure there is no chemical reaction between Rinse Solvent #1 and Rinse #2
- Do not use Alcohols as a rinse solvent for samples which contain sugars or proteins.
- In general, it is best to rinse, clean, and dry the U-tube after each and every measurement. The exception to this rule would be when the next sample is almost identical to the last sample. In this special case, the next

sample acts to wash out the previous sample. This sample replacement mode of operating works well when filling the U-tube using a peristaltic pump or using the gravity fill method with a funnel. In these cases, there are copious amounts of sample available to wash out the previous sample thereby ensuring that little or no cross contamination between samples occur.

## **8.2 Cleaning and Drying Prior to an Adjustment and/or Calibration**

All subsequent measurements are only as good as the last calibration adjustment done to the AlcoTest™. Therefore it is absolutely essential that every effort is made to ensure the best calibration-adjustment as possible. This begins with the best possible cleaning and drying of the U-tube.

A good practice in cleaning and drying prior to a calibration/adjustment is to double or even triple the amount of time and solvents used in normal daily operation. In other words, normal cleaning may consist of using about 10 ml of Rinse Solvent #1 followed by 10ml of Rinse Solvent #2 followed by 100 seconds of drying time. For the cleaning prior to a calibration/adjustment double or triple all of those values; use 20 to 30 ml of each solvent and set the drying time to 200 to 300 seconds or more.

## **8.3 Special Problem Cleaning Methods**

If care is taken to clean the AlcoTest™'s U-tube after each sample measurements and if the proper rinse solvents are used, there should never be any problems with cleaning the U-tube. However, problems can happen if

1. A sample is forgotten about and left remaining inside the U-tube for a long period of time or
2. A sample is put in the U-tube and the proper solvent is not used or
3. The sample may be cleaned after a measurement but is not cleaned completely and over time a gradual buildup of residue occurs.



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*Never stick pipe cleaners or paper clips or any other sharpened object down inside of the U-tube in an effort to clean the ID of the glass tube. These items will break the glass and require*

*expensive factory repair.*

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### **8.1.1 Four methods for problem cleaning:**

1. Room Temperature Soaking
  - a. Often, just allowing the Rinse Solvent #1 soak inside of the U-tube for 5 to 10 minutes will clean the U-tube. You may also try using a mild soap detergent. And, there are many commercially available cleaning solutions made for cleaning laboratory glassware. Most require diluting with water. And most work very well at room temperature. Never leave the cleaning solution inside the U-tube for periods of time longer than required. In addition to soaking, many times scrubbing with the cleaning solution is helpful pull back and forth on the plunger of the syringe which contains the cleaning solution for a scrubbing effect.
2. Melting the Residue
  - a. It is often possible to just increase the temperature of the AlcoTest™ and melt whatever residue is inside of the U-tube. This works best for difficult to clean samples which are very viscous or for samples like wax that have solidified inside the U-tube.
3. Hot Cleaning: Scrub and/or Soak
  - a. Warm or hot mild soapy water cleans much faster and better than cold soapy water. You could use a syringe and inject this hot soapy water into the U-tube pull back and forth on the plunger of the syringe to “scrub” the residue away. Also you may increase the temperature of the AlcoTest™ and let the soapy solution soak inside the U-tube for some period of time.



*WARNING: Never use any hot or warm solutions which could cause damage to the glass U-tube. Warm or hot caustics can etch and subsequently damage the glass. The same is true for some of the commercially available cleaning solutions. Read the directions on the label and use good*

The best general practice to follow when trying to solve a cleaning problem is to always use the least aggressive method(s) first. In other words, try cleaning at room temperature before cleaning at an elevated temperature. Also, use the lowest possible concentration (most dilute) of cleaning solution before trying a slightly more concentrated solution.

When in doubt about cleaning, please contact your Rudolph Research Analytical representative.



HINT

If none of the chemical methods above clean well; try the following:

4. Mechanical Method of Cleaning:

- a. If the above chemical cleaning does not work you can use a mechanical method. Please don't use pipe cleaners or put anything inside the U-tube as it may result in a broken glass U-tube and very expensive factory repair. Besides, even if a pipe cleaner can clean away stubborn dirt on the straight legs of the U-tube there is no way to clean the bend of the U-tube
- b. Use NaCl, that is, normal table salt found in the lunch room.
- c. Procedure: First grab a 3ml to 5ml luer syringe. Pull the plunger all the way out. Cap the luer tip off with your finger or some other capping device to keep the salt from not pouring back out. Fill the syringe about half way with this solid salt. Then with the luer tip still capped, add a few drops of water. Shake. Maybe add another drop or two of water. Shake again. What you are trying to make is a salt paste; you don't want the salt to all dissolve into solution. Now put the plunger back into the syringe.
- d. Next be **patient**. You are going to start pumping the plunger of the syringe back and forth into the nozzle inlet of the AlcoTest™. This is going to take several minutes to get the salt slurry into the glass U-tube. But it will go in; it just takes a little time; keep pumping back and forth. As the salt slurry gets into the U-tube it is abrasive enough to clean the glass tube but it will not harm the glass. After working this for several minutes take a good look at the U-



tube. Does it look 100% better? If so just rinse the salt out with water.

## **9. Calibration; Checking and Adjusting**

### **9.1 Definitions**

Calibration Check or Calibration Verification: It is the resulting procedure when a density measurement is compared to a known density standard. The AlcoTest™ is supplied from the factory with one density standard. Either this or some other standard is possible to use. Whenever a measurement is made and then this resulting value is compared to a known or published value, this process is considered a Calibration Check or Verification. This procedure does not change the density reading, it is only a confirmation of the performance of the AlcoTest™. At least one density standard is required for a Calibration Check.

Calibration Adjustment: This is a procedure that is done which affects the resulting readings of the AlcoTest™. That is, if a Calibration Check proves that the AlcoTest™'s results are incorrect, an Adjustment will bring the AlcoTest™ back into specifications so that it will measure within the required or specified accuracy. Calibration adjustments may be done with two or three density standards (normally air, water, and a third standard with a density greater than water and representative of the user's samples). A two-point calibration adjustment using air and water is best for most applications.

### **9.2 Calibration Checks – Verification**

The frequency of the Calibration Checks is done as required by the Quality Management or as outlined in your SOP. Some users may select to do informal calibration checks with pure distilled water (non-traceable) as often as several times a day. Then it could be selected to formalize and record the results as frequently as once a week to maybe infrequently as once a year using a traceable known density standard.

To begin a calibration check select **Menu > Calibration** from the Main Menu.

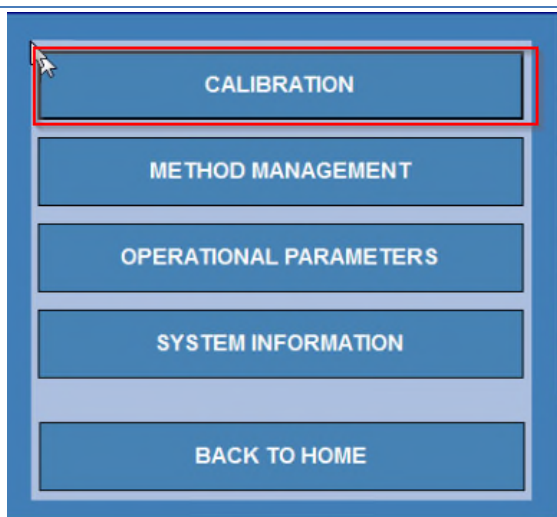


Figure 9.1 – Calibration Menu

When entering the Calibration Menu, you may be asked to supply a password. The Factory default password is '519'. Password protection may be turned off or edited. See the Lab Manager's Password.

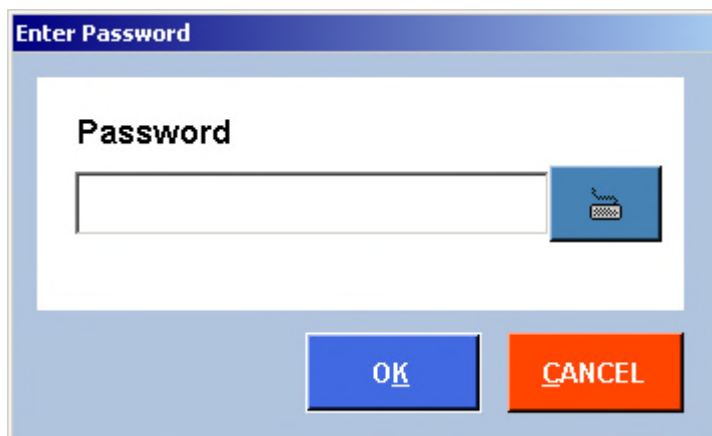


Figure 9.2 Calibration Password

Once the proper password has been entered and "OK" is selected/touched the following screen will open.

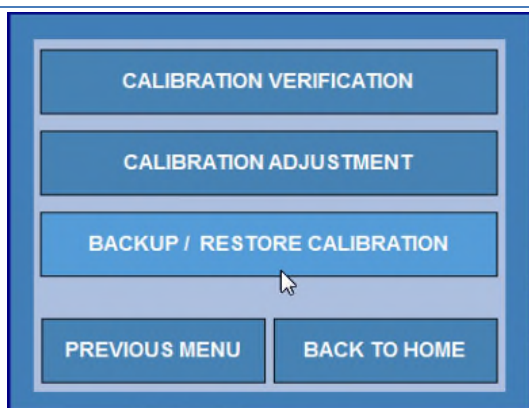


Figure 9.3 – Backup/Restore Calibration



*Only one Calibration Verification method is pre-loaded by the Factory. By selecting “Add”, other standards and temperatures are possible. This list of Calibration Verifications may grow as large as required.*

Select Calibration Verification from the menu. The following screen will be displayed.

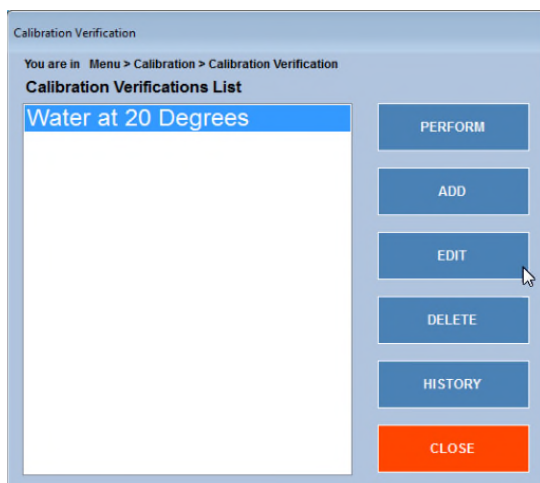


Figure 9.4 Calibration Verifications List

One Calibration Method is installed by default from the factory. Other Calibration Methods may be added using this menu.

After selecting the desired Calibration Verification Method, the measurement is done as is any other measurement. These results are automatically saved within the AlcoTest™'s internal memory as well as in any external path defined by that method. These results cannot be either deleted or changed. Be sure to follow the Cleaning and Drying Instructions as outlined in Chapter 8.2 prior to any Calibration.



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*The AlcoTest™ AlcoTest™s have a feature whereby a single calibration adjustment done at 20°C will permit accurate measurements at all temperatures. It is possible to do a calibration adjustment at other temperatures, but by doing so the feature of making accurate measurement at other temperatures will no longer be effective.*

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### **9.3 Two-Point Calibration Adjustment**

If the AlcoTest™ has shown that it is making measurements correctly and within the limits of uncertainty of measurement (defined as the combined uncertainties of both the AlcoTest™ and the density standards itself) a Calibration Adjustment cannot make the instrument more accurate.

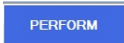
In other words, you cannot fix something which is not broken. Therefore, it is best to perform an Adjustment only when necessary to correct the AlcoTest™'s measurement results when they are not correct as shown by a Calibration Verification.

If the AlcoTest™ has failed a Calibration Verification it is recommended that the U-tube be again cleaned and dried carefully as outlined in Chapter 8 and the Calibration Verification is done a second time. If then if it fails this verification it is safe to perform the Calibration Adjustment.





*Be sure to follow the Cleaning and Drying Instructions as outline in Chapter 8.2*

Select the Air/Water Calibration Adjustment, hit  and follow the command prompts.

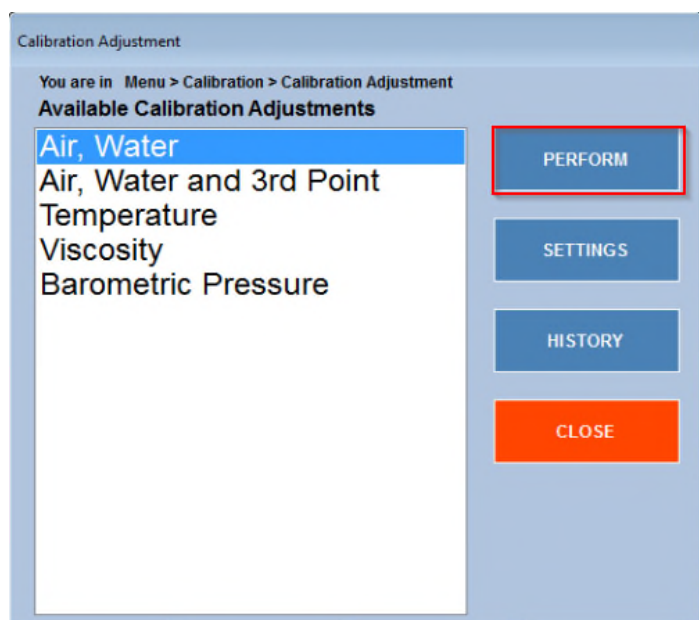



Figure 9.5 – Calibration Adjustment Menu

If necessary, you may change the Calibration adjustment settings before performing a procedure by pressing  on Figure 9.5. You will see instantly a new window as show in Figure 9.6

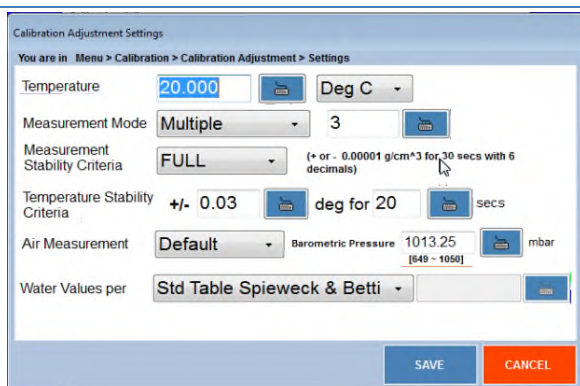


Figure 9.6 – Calibration Adjustment Setting dialog

From this menu it is possible to define how you wish to do the two point air and water calibration adjustment.

Rudolph Research Analytical recommends using 20°C as the calibration adjustment temperature as by doing so it is then possible to make accurate measurements at any other temperature.

While it is possible to do a calibration adjustment at temperatures other than 20°C, the AlcoTest™ will no longer be accurate at all other temperatures; it will only be accurate at the other calibrated temperatures.

For the air measurement, you may select a Default Barometric Pressure value or use the Internal Barometer to correct the air's density.

During the air calibration, when prompted, enter the average of typical barometric pressure for the area in which the AlcoTest™ is located. For sea level that value is 1013 mbar. For locations which are 1,000 ft above sea level that value is about 976 mbar, 2,000 ft above sea level it is about 942 mbar, and at 4,000 ft above sea level it is about 875 mbar.



Figure 9.7 – Calibration Adjustment – local Air Pressure based on Altitude

You will be prompted to confirm your selection of local air pressure.

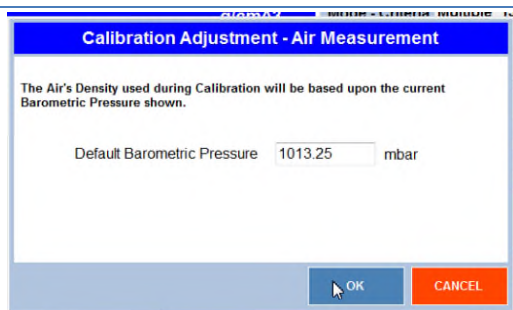


Figure 9.8 – Calibration Adjustment - AIR

At this point you may either skip the air calibration or complete it. Once is done, you will have the option to water calibrate the instrument as shown in Figure 9.7

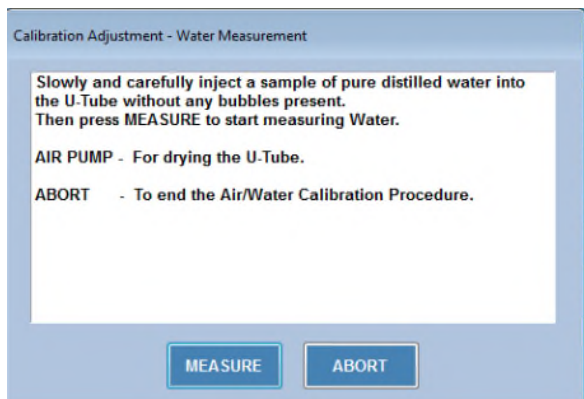


Figure 9.9 – Calibration Adjustment – Water Measurement

## 9.6 Temperature Calibration Verification & Adjustment

The temperature inside the U-tube may be verified using a Fluke Hart Handheld Thermometer P/N 1523 with temperature probe P/N 5622-10 and probe calibration P/N 1923-10 or its equivalent.



*The Fluke Hart thermometer's certificate of calibration must be valid. Serial numbers are recorded for thermometer and probe on the Measurement Data Sheet.*

### 9.6.1 Temperature Verification

Remove one of the filling nozzles and carefully place the Fluke Hart Thermometer probe inside the internal diameter of the U-tube.

Perform this procedure very slowly and with very little force as **the glass is very fragile!** Reference Figure 9.10 below.



Figure 9.12 – Temperature Verification with a certified Fluke-Hart Thermometer



Figure 9.13 – Verify Temperature

Set the AlcoTest™ temperature using the dialog box on the right and permit sufficient time for the U-tube and the thermometer probe to come to complete thermal stability. This may require up to 10 minutes.

Then compare the AlcoTest™'s sample temperature as displayed to the temperature reading on that of a certified thermometer. The results of the two temperature readings must be within the combined accuracies of the AlcoTest™ and that of the thermometer.

The AlcoTest™'s temperature's accuracy is  $\pm 0.03^{\circ}\text{C}$  and the thermometer's probe has an accuracy of  $\pm 0.04^{\circ}\text{C}$ . The combined maximum error or difference between the two readings is therefore  $0.07^{\circ}\text{C}$ .

If these two readings agree within the above tolerance,  $0.07^{\circ}\text{C}$  or less, then the AlcoTest™ is properly calibrated and does not require Temperature Calibration Adjustment.

If there is a discrepancy – follow the procedure to Adjust the Temperature Calibration given in the next section.



*Note: The RRA Factory has the ability to do a much more accurate temperature calibration than is possible in the field. Therefore, returning the instrument to the Factory is recommended if there is a persistent temperature discrepancy.*

## 9.6.2 Temperature Calibration Adjustment

Always follow the Probe Insertion Instructions above for the Temperature Verification prior to deciding to perform a Temperature Calibration Adjustment.

*NOTE: If the instrument passes verification and is within specification for temperature, doing a Temperature Calibration Adjustment **will not** make the instrument any more accurate.*

It is rare that the temperature in the AlcoTest™ should go out of calibration. In the event that the AlcoTest™ requires a Temperature Calibration Adjustment you may opt to have the Factory do this adjustment or alternately you may enter the Calibration Adjustment menu as shown and select Temperature.

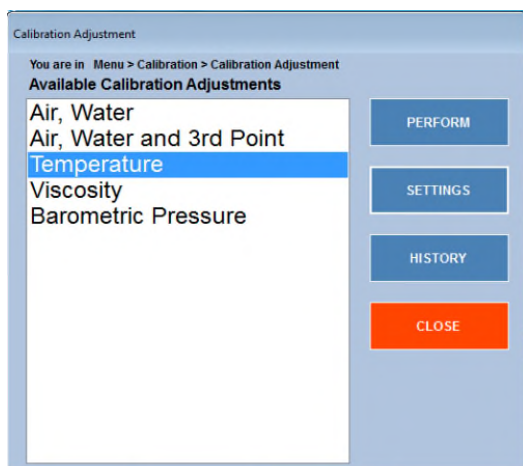


Figure 9.14 – Calibration Menu

The AlcoTest™ requires adjustments at 3 temperatures. These temperatures are 20°C, 40°C, and 60°C.

The factory settings of 20°C, 40°C, and 60°C must be used. Press or click the **PERFORM** button.

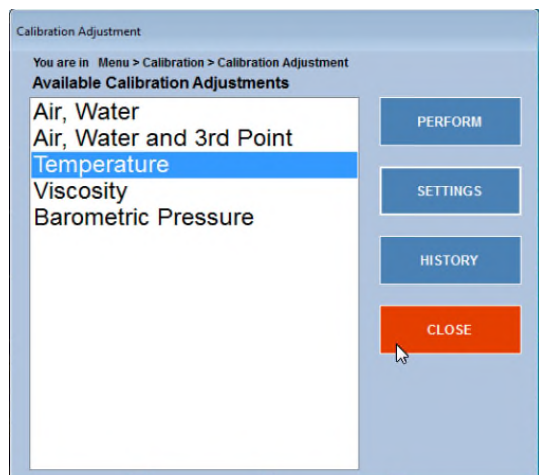


Figure 9.15 – Calibration Adjustment – Temperature Calibration

Follow the instructions displayed on the screen. Allow 20 minutes or more between temperature changes and confirm that the temperature is stable for both the AlcoTest™ and the Fluke-Hart Thermometer.

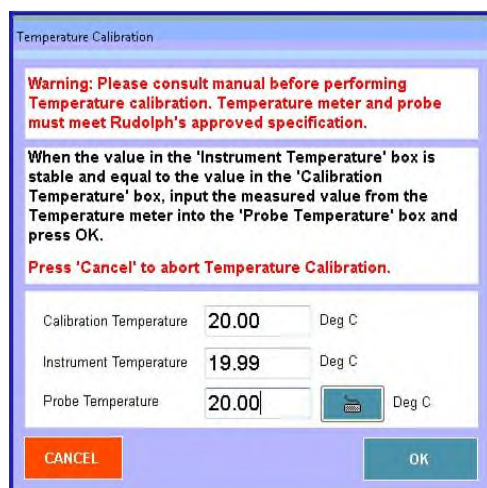


Figure 9.16 – Temperature Calibration



**HINT**

*It is advisable to re-check the measurement accuracy after re-assembly of the nozzle which was removed for the temperature verification and/or temperature adjustment. It is very possible that the tension between the nozzle and the opening to the glass U-tube may be slightly different and will not oscillate exactly as before. Therefore, an air and water calibration check (verification) is always best. Perform a calibration adjustment, if required.*

## 9.7 Viscosity Calibration Adjustment

The viscosity calibration adjustment was done at the factory and normally is not required to redo again by the end user. However, this calibration is easy to do. All that is required is a viscosity standard which has a known density.

It is best to use a viscosity standard which has an absolute viscosity of between 150 to 200 mPa.s at room temperature. The actual viscosity value is not needed for this calibration, it is only necessary to know the density of this standard.

From: **Menu > Calibration > Calibration Adjustment** ; highlight **Viscosity**

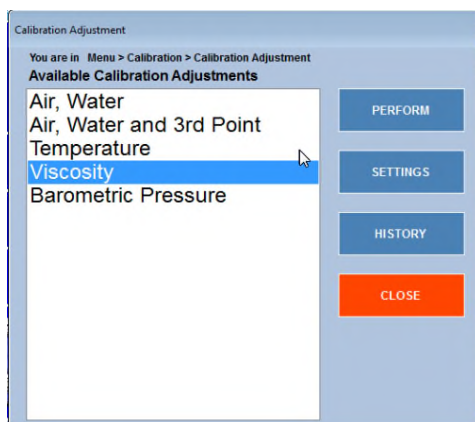
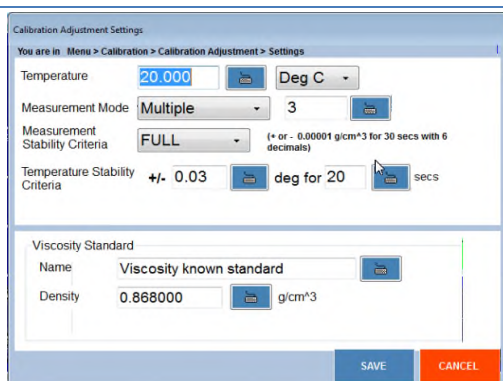


Figure 9.17 – Viscosity Calibration

Next select **“Settings”**. A Window will open as shown.



Calibration Adjustment Settings

You are in Menu > Calibration > Calibration Adjustment > Settings

Temperature: 20.000 Deg C

Measurement Mode: Multiple 3

Measurement Stability Criteria: FULL (± or - 0.00001 g/cm³ for 30 secs with 6 decimals)

Temperature Stability Criteria: +/- 0.03 deg for 20 secs

Viscosity Standard

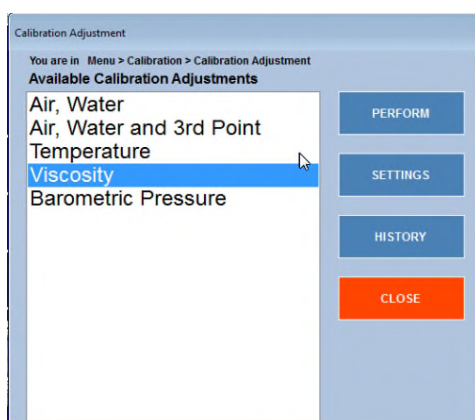
Name: Viscosity known standard

Density: 0.868000 g/cm³

SAVE CANCEL

Figure 9.18 – Viscosity Adjustment Settings

Type in the correct density in g/cm<sup>3</sup> for this standard being used and then hit on **“SAVE”**.



Calibration Adjustment

You are in Menu > Calibration > Calibration Adjustment

Available Calibration Adjustments

- Air, Water
- Air, Water and 3rd Point Temperature
- Viscosity
- Barometric Pressure

PERFORM

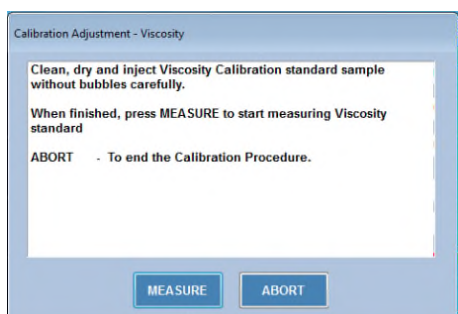
SETTINGS

HISTORY

CLOSE

Figure 9.19 – Perform Viscosity Calibration

Select **“PERFORM”**. Then follow the system prompts on the display.



Calibration Adjustment - Viscosity

Clean, dry and inject Viscosity Calibration standard sample without bubbles carefully.

When finished, press MEASURE to start measuring Viscosity standard

ABORT - To end the Calibration Procedure.

MEASURE ABORT

Figure 9.20 – Viscosity Calibration wizard

## 10. Printers and Network Connections

The AlcoTest™ series of AlcoTest™s supports connection to modern Ethernet networks and to both local and networked printer devices. The support for these advanced capabilities is provided through the Windows Embedded operating system which is the execution environment for the AlcoTest™ application.

Windows Embedded is a very robust and stable platform, providing familiar interfaces to add Plug-and-play type devices and most networks with ease. The AlcoTest™ uses a variant of Windows that has been customized for laboratory equipment use. This variant allows certain protections to be put in place to protect the data and the operating system from inadvertent damage. One of these features is called Disk Protection.

Disk Protection has the side effect of preventing a normal user from installing low level applications, such as network drivers or printer drivers. Often these drivers need to be installed in a user's environment. As a consequence, Disk Protection has to be 'turned off' temporarily.

The AlcoTest™ software fully supports and controls this Disk Protection feature. The following sections will describe the general process for Enabling and Disabling Disk Protection as the user may be required to do when installing a printer or a network connection.



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*Note: If you are not comfortable or familiar with the setup of Network Connections or Printer Drivers STOP and consult with your local IT personnel for assistance.*

---

### 10.1 Basic Steps required for Printer or Network Configuration

It will be necessary to access the Windows Embedded Control Panel and be able to turn off Disk Protection in many of the following procedures. Therefore, this procedure will be outlined only once and will be referred to in the remainder of this document as the "Basic Steps".

### 10.1.1 Basic Steps:

1. Click the **Menu** button, enter the password and click OK. The factory default password; if it has not been deactivated or changed by Lab's Manager; is **123**.

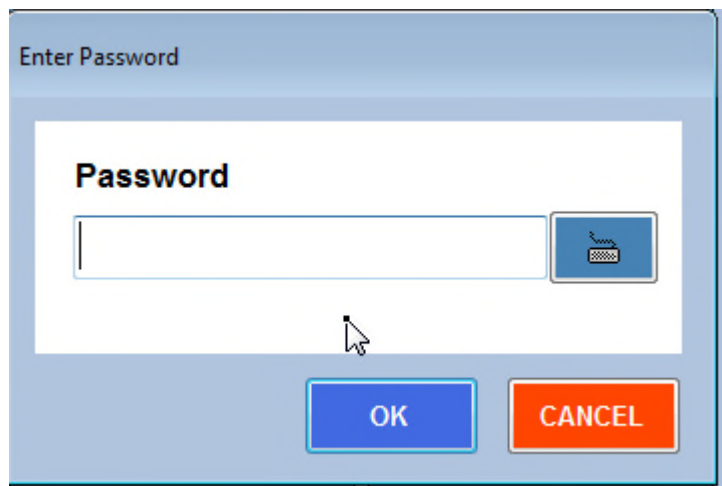


Figure 10.1 – Enter Menu Password (if required)

2. Select **Operational Parameters** from the menu.

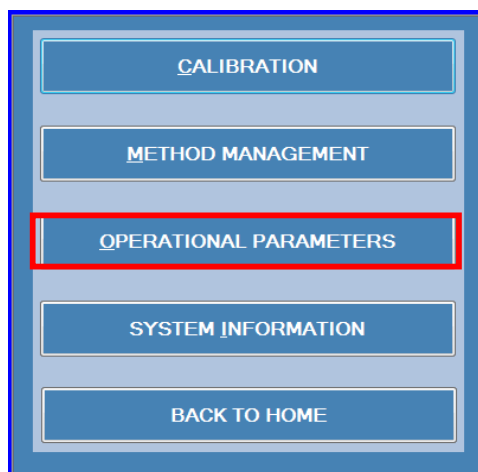


Figure 10.2 – Select Operational Parameters



3. Select **Instrument Configuration** from the Operational Parameters menu.

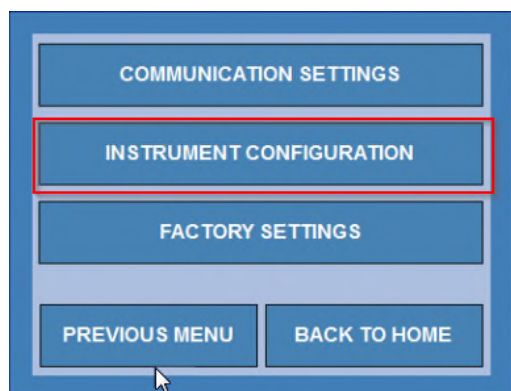


Figure 10.3 – Instrument Configuration

4. Select **Control Panel** from the Instrument Configuration menu.

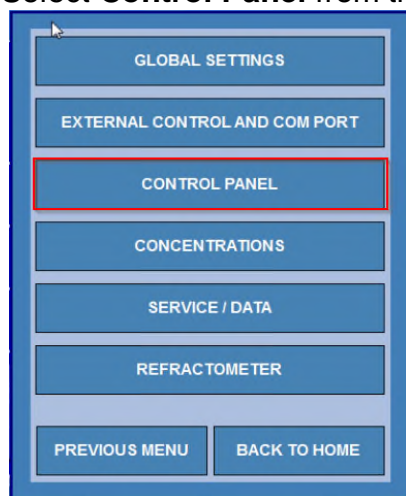


Figure 10.4 – accessing the Windows Control Panel

5. Select **Turn Disk Protection Off** from the AlcoTest™ Control menu.

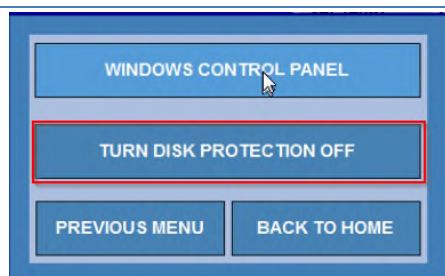


Figure 10.5 – Turning Off Disk Protection

6. You will see the warning message shown in Figure 10.6 below. Click the **Yes** button. The AlcoTest™ system will automatically restart. Please allow 20 to 30 seconds for the system to become operational again.

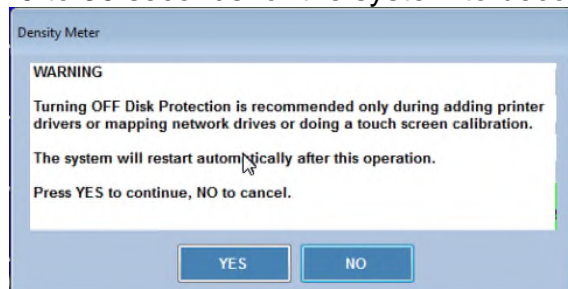


Figure 10.6 – Turn Off Disk Protection - Confirmation Dialog

7. When system reboots you will see a red box in the Main Screen header showing that Disk protection is off (see Figure 10.7)

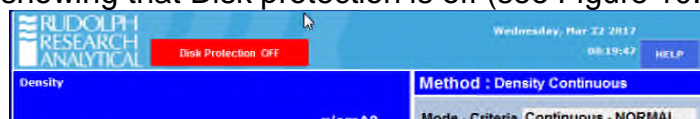


Figure 10.7 – Disk Protection Status Indicator

- Click the **Menu** button and enter the password (refer to Figure 10.1). The factory default password is 123, if was not modified by the Lab's Manager.
8. Click Operational Parameters and select Instrument Configuration from the menu.
9. Select **Control Panel** from the Instrument Configuration menu (see Figure 10.4)
10. Select **Windows Control Panel** from the AlcoTest™ Control Panel menu.

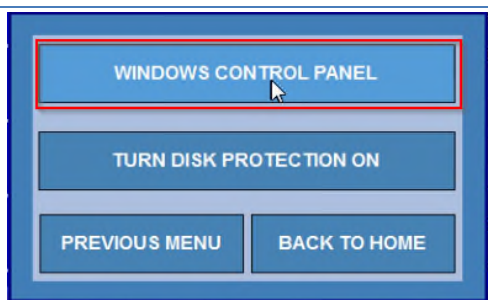


Figure 10.7 – Accessing the Windows 7 Embedded Control Panel

11. You are now in the Windows 7 Embedded Control Panel as below.

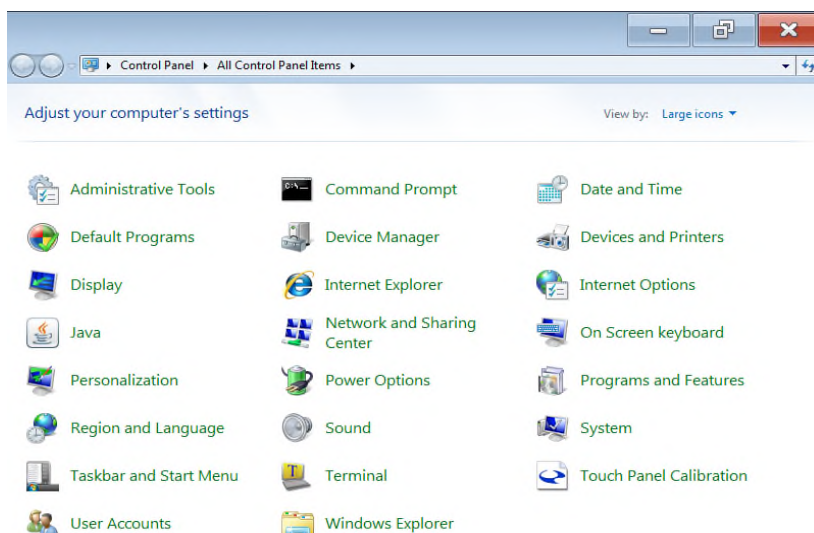


Figure 10.8 – Windows Control Panel

## 10.2 Installing Plug-n-Play Local Printers

The AlcoTest™ allows the connection of any of the 200 plus USB printers whose drivers are preloaded in Windows Embedded. Follow the instructions below to install a plug and play compliant USB printer on the AlcoTest™. See Appendix D for the complete list of printers.



*Most printers released in the last 5 years are plug and play compliant.*

Connect the USB cable from the printer to the AlcoTest™. Be sure both instruments are turned ON. It may take a minute but the Windows Embedded software will recognize the printer.

You may see some Windows dialog boxes pop up and disappear – this is normal. Once the printer is fully installed you should get a message that the printer is ‘Ready for Use’

You now need to set this new printer as your default printer. To do this ensure that disk protection is off as outlined above in section 10.1 - “Basic Steps”.

Once in the Control Panel select Devices and Printers.

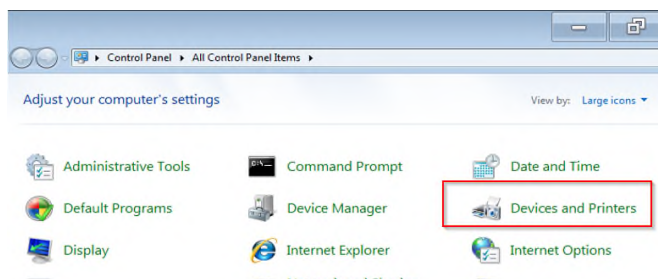


Figure 10.9 – Devices & Printers

The AlcoTest™ screen will display the current set of connected devices and printers. An example of this screen is below.

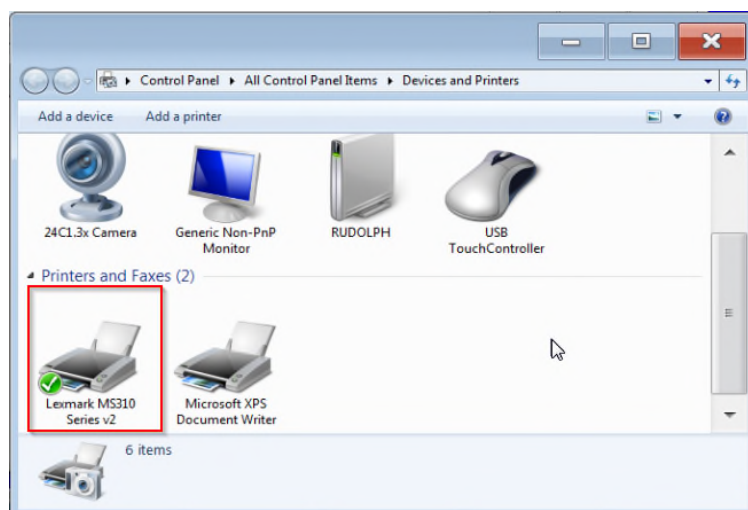


Figure 10.10 – Connected devices and Printers

If using the touch panel 'LONG Press' (press your finger on the icon and hold it there) or Right click if using a mouse on the printer you wish to set as the default printer.

The following dialog will appear.

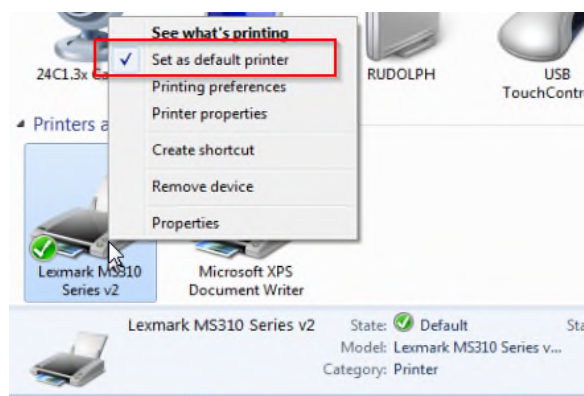


Figure 10.11 – Set default Printer

Click or press “Set as Default Printer”. A check will appear next to the device and a green checkmark will also appear next to its picture on the Devices and Printers screen.

### **10.3 For a Local Printer which is not Plug-n-Play**

For some cases it will be necessary to load a printer's driver. Normally this will only be required for older printers, or printers which are not connected directly to the AlcoTest™ via the USB ports.

---

*You should load a driver on the AlcoTest™ ONLY when absolutely required.*



*Some printers ship with printer management software, additional editing software and additional fonts. You do not need these or want these to use resources on your AlcoTest™. Most printer manufacturers have just the printer drives available for download on their web sites.*

*AS PREVIOUSLY NOTED: If you are not comfortable or familiar with the setup of Network Connections or Printer Drivers STOP and consult with your local IT personnel for assistance.*

---

#### **10.3.1 Loading a custom or older Printer Driver**

This process will generally require some expert knowledge about your specific printer. The printer driver is usually located on the manufacturer website or possibly with the software CDROM that shipped with the printer. This driver must be located and copied onto a USB thumb drive. Generally this process is done using another computer – not the AlcoTest™ itself.

Once the proper printer driver is located and copied to the thumb drive follow the process below.



- 1) Load the printer's driver onto a USB thumb drive.
- 2) Follow the Basic Steps as outlined in section 10.1 above.
- 3) Plug the USB thumb drive device containing the printer drivers (such as a USB flash drive) into one of the AlcoTest™'s USB ports.
- 4) Connect the USB cable from the desired Printer to AlcoTest™. When the Found New Hardware wizard starts, select **No, not this time** and click **Next**. (See Figure 10.10)



Figure 10.12 – Found new Hardware wizard

- 5) Select Install from a list or specific location (Advanced) and click Next.

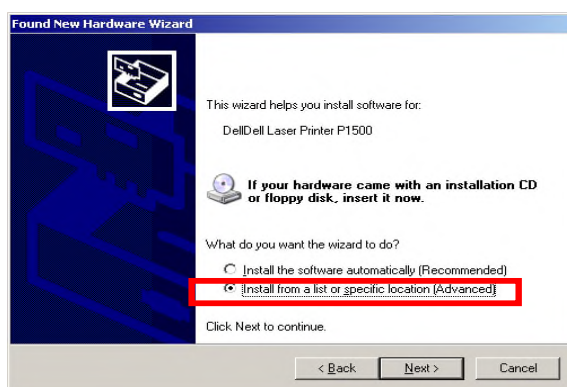


Figure 10.13 – Found New Hardware Wizard

- 6) Select **Search for the best driver in these locations**. Only select the **Include this location in the search**: check box and click **Browse** to

navigate to the folder on the USB storage device where the printer drivers are stored. Click **Next**. (See Figure 10.12)

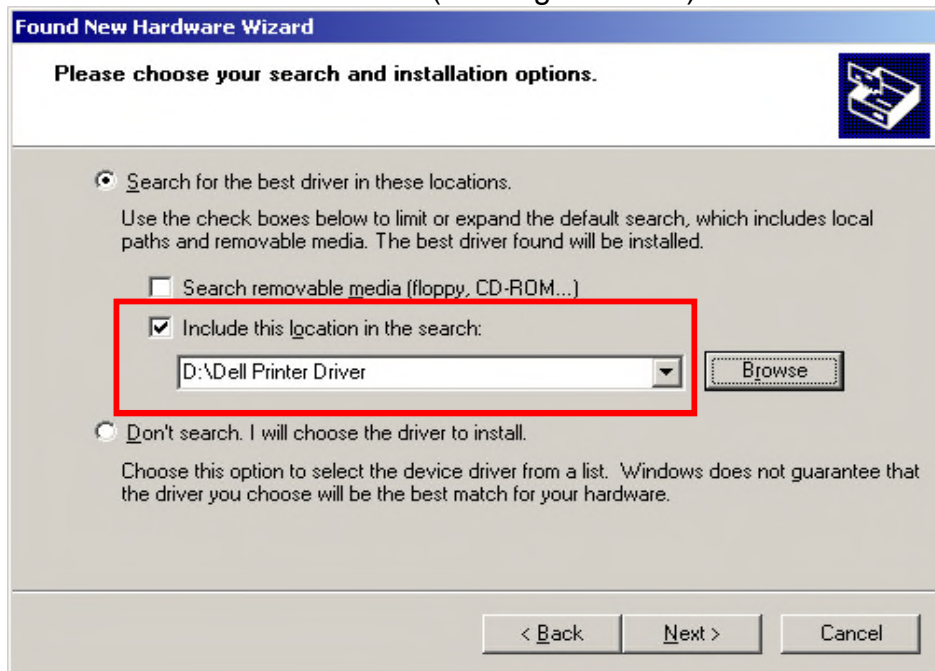


Figure 10.14 – Search for Driver in Specific Locations

- 7) If presented with a list of printers, select your specific model printer from the list, then select **Next**

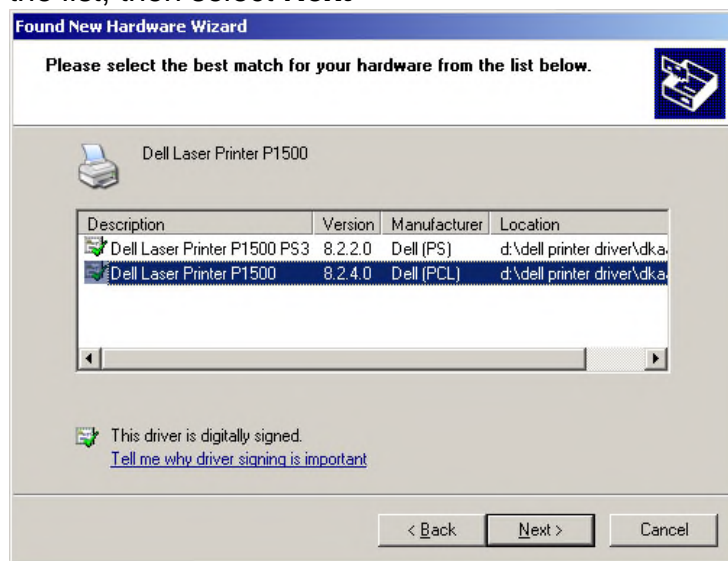


Figure 10.15 – New Hardware Wizard Printer List

- 8) Select Finish.
- 9) Double click the Devices and Printers Icon as shown in Figure 10.14 below.

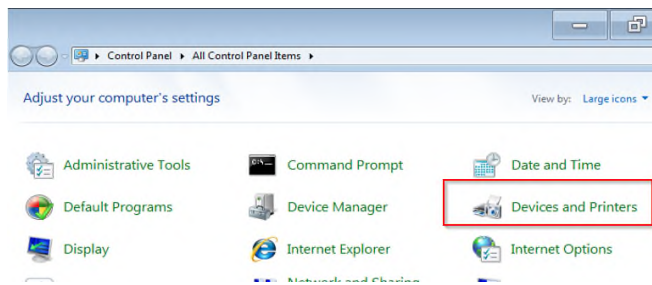


Figure 10.16 – Control Panel – Devices and Printers

- 10) Right click on the printer you just installed and select Set as Default from the menu.

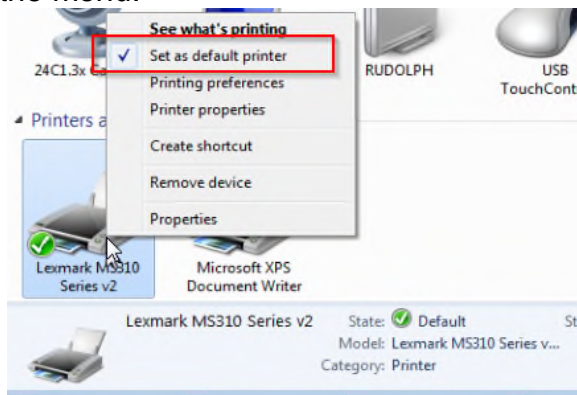


Figure 10.17 – Set default Printer

- 11) Close the Devices and Printers window by clicking the X in the top right hand corner of the windows. This will return you to the AlcoTest™'s Control Panel menu. Select **Turn Disk Protection On**. The system will display a message that the AlcoTest™ will restart. Click **Yes** to continue.

After the system restarts, the AlcoTest™ is ready to print to your printer.

## 10.4 Serial Printers

Most older serial printers are not plug and play. The instructions below show how to install the drivers required to use such a printer.

- 1) Follow the Basic Steps listed earlier to gain access to the Control Panel.
- 2) Once in the Control Panel select **Devices and Printers**.
- 3) Select **Add A Printer** at the top of the window as shown in the image below. (see figure 10.16)

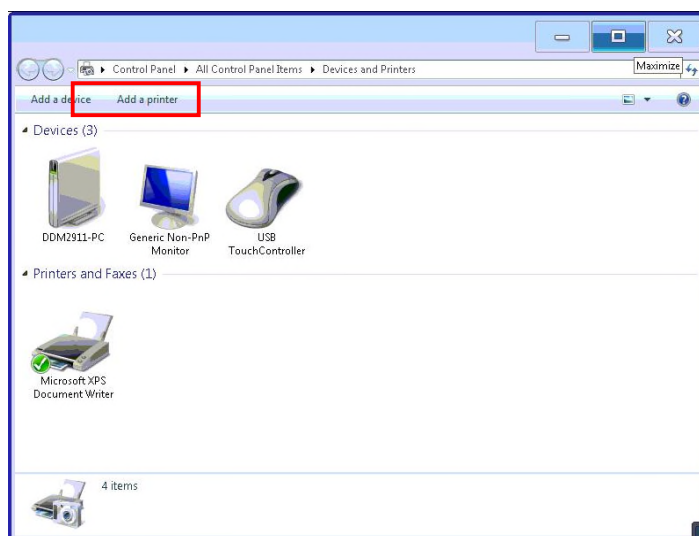


Figure 10.18 – Select the Add a Printer option

- 4) The Add Printer dialogue will start as shown below in Figure 10.17.

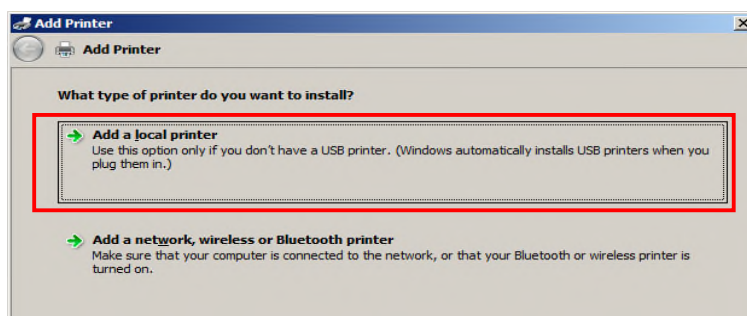


Figure 10.19 – Add a non plug-n-play local printer

- 5) Select “**Add a local printer**”. (Figure 10.17)
- 6) Click **Next** and select the port the printer is attached to on the back of the AlcoTest™. For the serial port on the back of the AlcoTest™ select **COM2** for an older serial printer. (figure 10.20) NOTE: This does not apply to local USB connected printers.

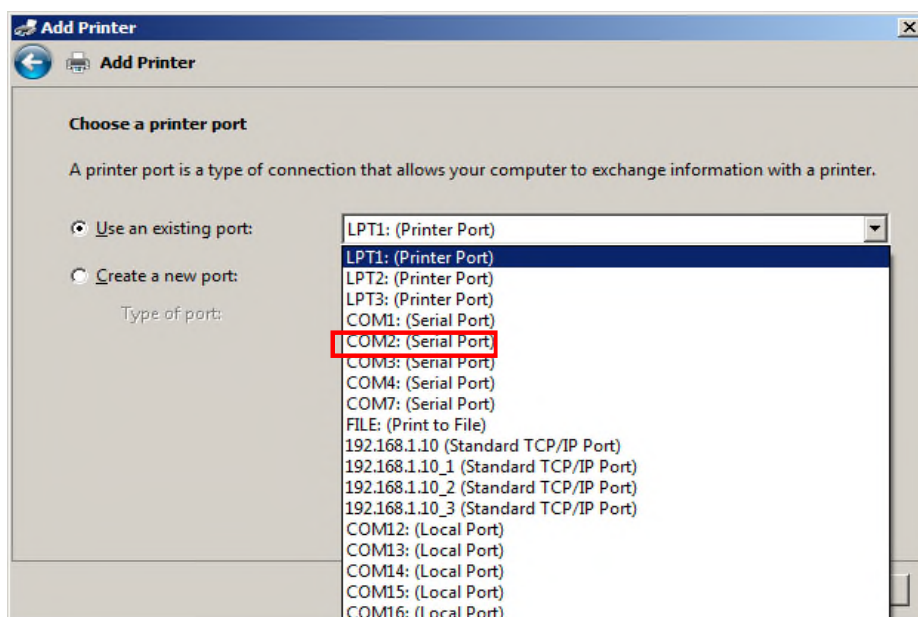


Figure 10.20 – Add a serial printer – COM Port Selection

- 7) Once the correct port is selected hit **Next**.
- 8) On the Add Printer dialogue box shown below (Figure 10.19) select the “**Have Disk**” option and point it to where you saved the printer drivers on your USB drive.



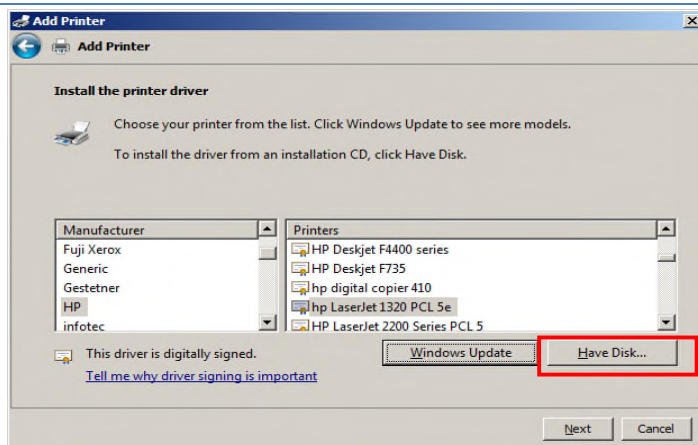


Figure 10.21 – Add Printer

- 9) Navigate to the USB storage device or network location where the drivers for the printer to be installed are located as shown in Figure 10.20.

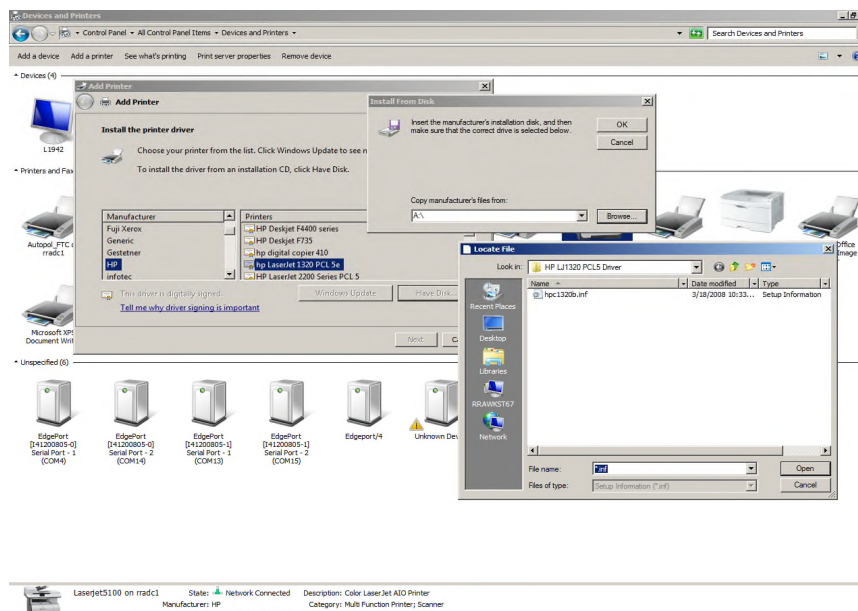


Figure 10.22 – Install custom Driver

- 10) Select your printer from the list and click **Next**.



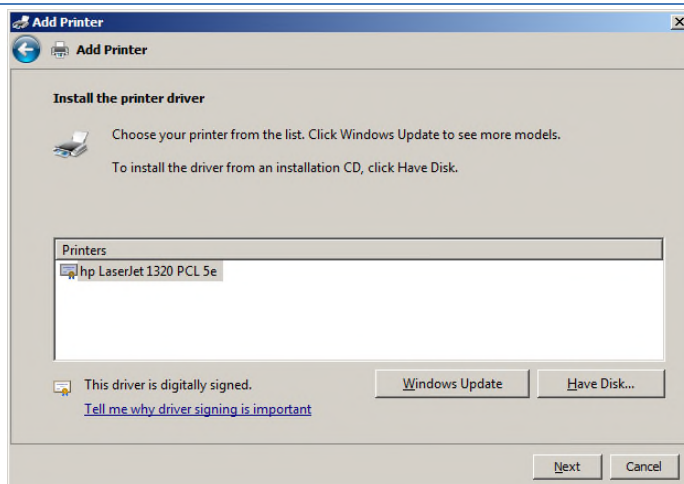


Figure 10.23 – Install specific driver from location

11) Enter the name you would like to call the printer. See figure 10.22 below.

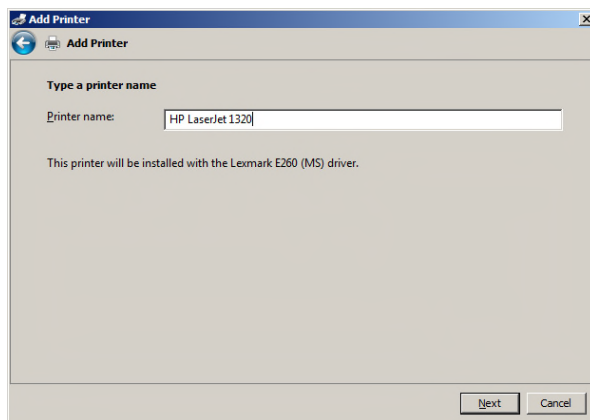


Figure 10.24 – Name the new Printer

12) You may see a window that asks if you would like to share the printer. Do not share the printer! and select **Next**. See Figure 10.23.

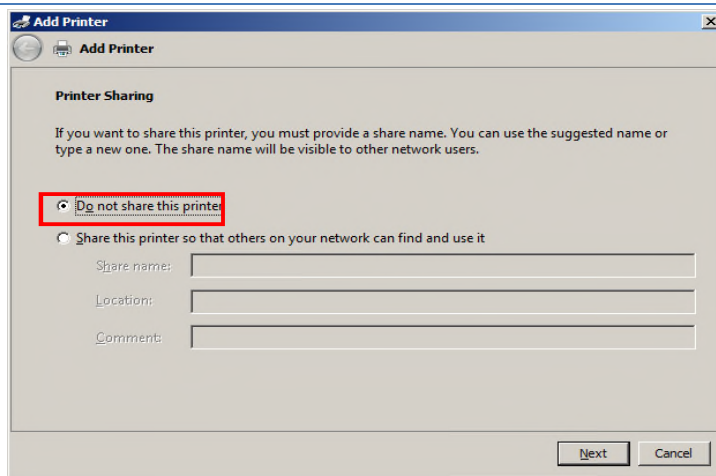


Figure 10.25 – Set for no Share

- 13) Click **Next**. Check the dialogue box for “**Set as the default printer**” and then click “**Print a test page**”. and click Finish.

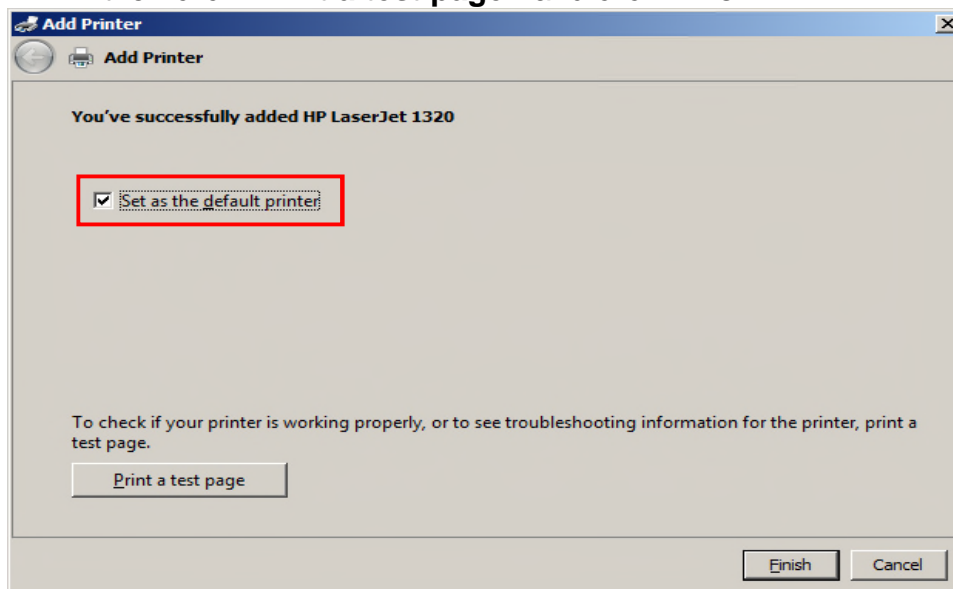


Figure 10.26 – Print a Test Page

Close the Devices and printers window by clicking the X in the top right hand corner of the window. This will return you to the AlcoTest™'s Control Panel menu. Select **Turn Disk Protection On**. The system will display a message that the AlcoTest™ will restart. Click **Yes** to continue.

After the system restarts, the AlcoTest™ is ready to print to your printer.

## 10.5 Print to a TCP/IP Printer Attached to a Network

By default AlcoTest™ assumes that your network supports TCP/IP and is using DHCP (your server automatically assigns an IP (internet protocol) address to the AlcoTest™ when you attach the AlcoTest™ to your network via the Ethernet port. This is also sometimes called a CAT5 or CAT6 port. This port is located on the back of the instrument).



---

*If the above network conditions are not met or if you do not know if the AlcoTest™ is properly configured on your local network STOP and consult with your local network administrator or IP department.*

---

To install a TCP/IP printer attached to a network follow the instructions below:

- 1) Connect the AlcoTest™ to the TCP/IP network by connecting a patch cable to the ETHERNET Network port on the back of the AlcoTest™.
- 2) Connect the other end of this patch cable to an appropriate network port.

---

*If you do not know if a particular network port is correct or appropriate for connection to the AlcoTest™ unit **STOP** and consult with your local network administrator or IT department.*

---



***IT IS NOT RECOMMENDED TO ATTEMPT TO CONNECT THE AlcoTest™ TO A NETWORK PORT UNLESS IT IS PROPERLY CONFIGURED!***

---

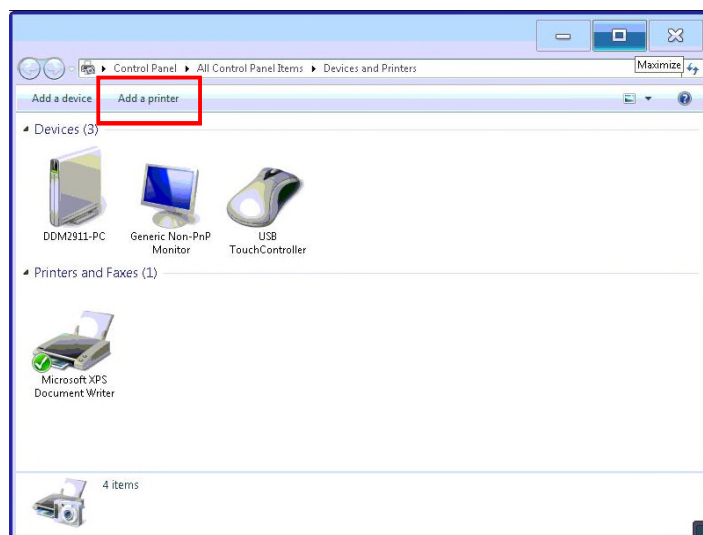
---

*Connecting to a misconfigured network port or a port that 'looks' like a network port but may be for example a local telephone port may cause damage to your network or to the AlcoTest™ unit.*

*WHEN IN DOUBT – **STOP** – and consult the proper personnel within your organization.*

---

- 3) Follow the Basic Steps to reach the Control Panel.
- 4) Once you are in the Windows Control Panel select “Devices and Printers”.
- 5) Select **Add a printer** from the menu at the top of the window. (see figure 10.25) below



*Figure 10.27 – Adding a Network Attached printer*

- 6) When the add a printer dialogue box pop up select “**Add a network, wireless or Bluetooth printer**”. (figure 10.26).

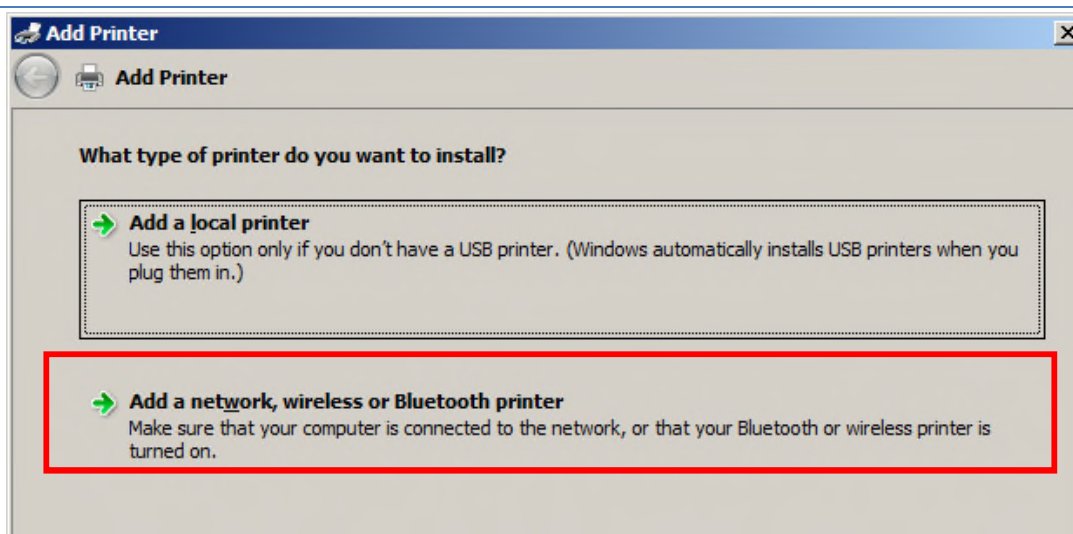


Figure 10.28 – Adding a Network Printer

- 7) If your network has printer discovery turned on a list of network printers will be displayed as shown in Figure 10.27 below.

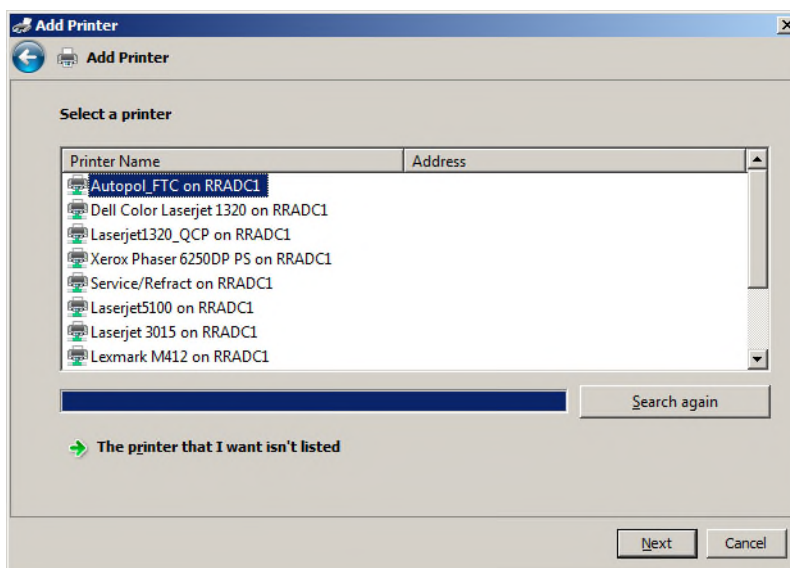


Figure 10.29 – Select Printer Driver



- 8) If the printer you want to add is shown in the list select it and click **next** and you can skip ahead to step 10. If the printer you want to add is not shown click **"The printer I want isn't listed."**
- 9) You will be presented with the "Find a printer by name or TCP/IP address" dialogue box with three options as shown below.

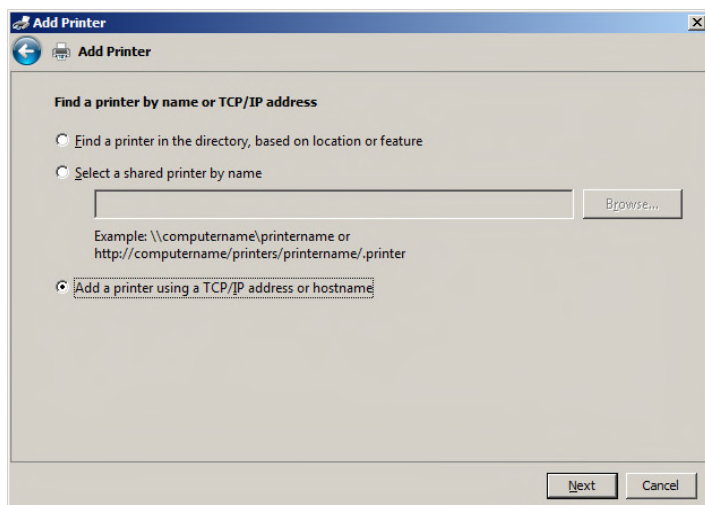


Figure 10.30 – Add Printer by TCP/IP

- 10) Select whichever option is applicable. If you know the printers IP address select **Add a printer using TCP/IP address or hostname** as this is the preferred method and hit next.
- 11) On the next window for Device Type: **choose Autodetect**. For Hostname or IP address enter the Hostname or IP address. For Port name should automatically fill in as you enter the IP address as shown below in Figure 10.29
- 12) Make sure Query the printer and automatically select the driver to use is selected.

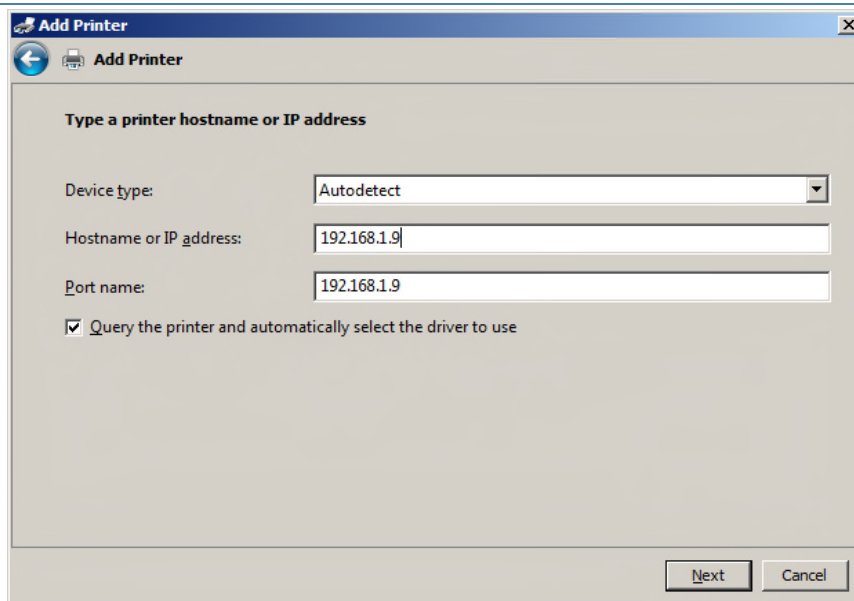


Figure 10.31 – Network Printer Configuration

13) Click Next and select add a Local Printer. See Figure 10.30 below.

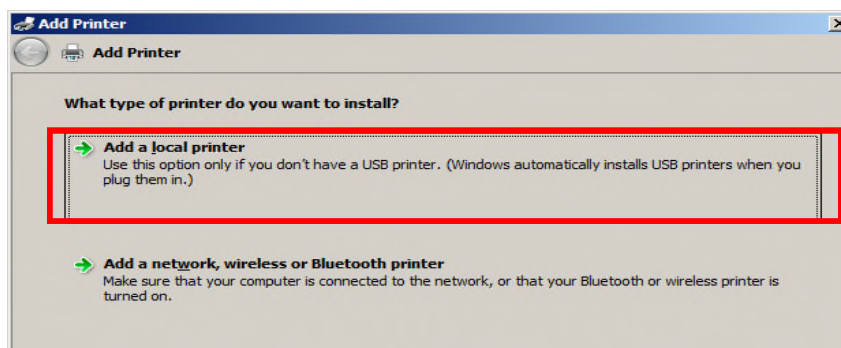


Figure 10.32 – Local Printer – TCP/IP port

14) Select **Create a new port:** Next to **Type of port:** select **Standard TCP/IP port** and click **Next** as shown in Figure 10.31.

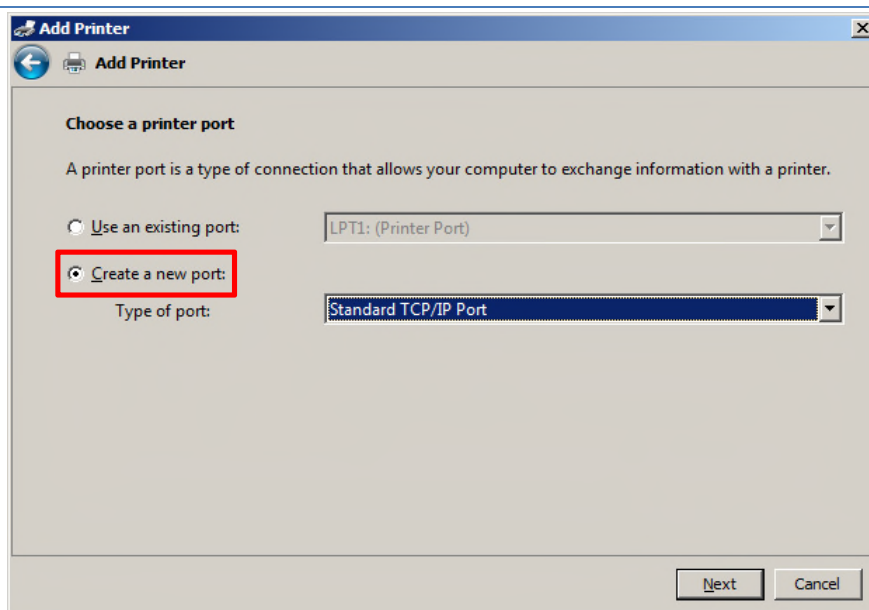


Figure 10.33 – Configure Local TCP/IP port settings

- 15) On the next window for Hostname or IP address enter the Hostname or IP address of the printer you want to add. Port name should automatically fill in as you enter the IP address as shown below in Figure 10.33. Make sure the **“Query the printer and automatically select the driver to use”** box is checked. Hit **next**.

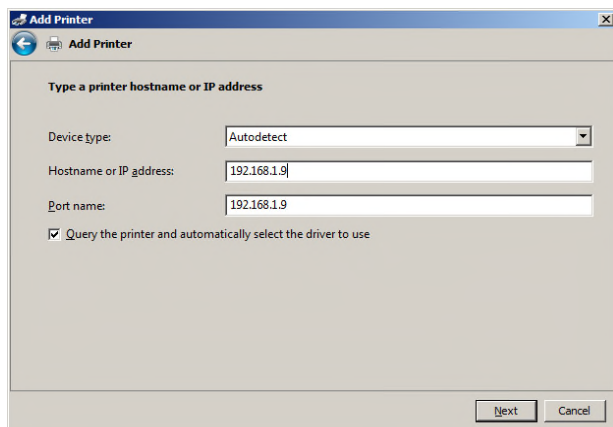


Figure 10.34 – Driver selection

- 16) If Windows was able to automatically configure the printer you will see a screen similar to Figure 10.34 below and you can click Next.

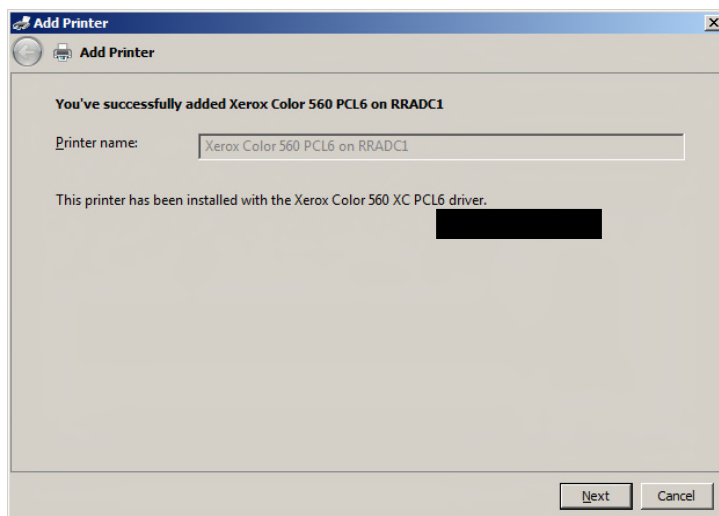


Figure 10.35 - Confirmation

- 17) If windows was unable to automatically select the proper driver to use you will be presented with the same screen as shown in Figure 10.19 and you will need to click “**Have Disk**” and specify a location where you have the printer driver saved.
- 18) Once you have selected the proper driver or the computer has automatically installed the proper driver you will be presented with Figure 10.35 as shown below indicating a successful printer installation.
- 19) Make sure “**Set as the default printer**” is checked and click “**print a test page**” and then click “**Finish**”.

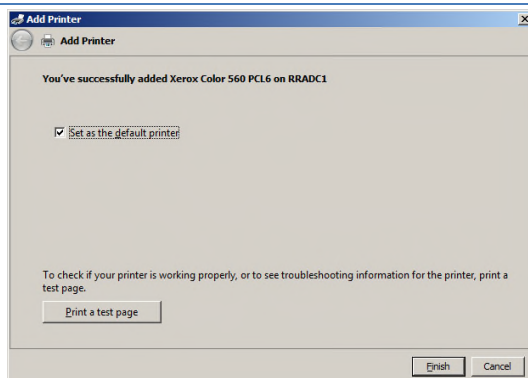


Figure 10.36 – Printing a Test Page

## 10.6 Access Network Drives

The instructions for accessing a network drive with the AlcoTest™ assume the following:

- The network provides DHCP. It is possible to set a static IP, but the instructions assume the IP address is set dynamically. If you plug the AlcoTest™ into your network via the Ethernet jack (labeled Network) on the back of the AlcoTest™, the instrument will use DHCP to ask for an automatically assigned IP address.
- The network drive is on a Windows based network.



*CAUTION: The AlcoTest™ is not currently designed to join a Windows Domain. You can map to a network drive by just providing user credentials of someone who has security privileges to the network folder. There should be no reason to use the Windows Control Panel Network Connections feature.*

*Joining the AlcoTest™ to a Windows Domain may have undesirable effects on both the AlcoTest™ unit and the Network Operation itself. Before attempting to join a AlcoTest™ unit to a Windows Domain **STOP** and consult with your network administrator or IT support department.*

To add a network drive:

- 1) Connect the AlcoTest™ to the TCP/IP network by connecting a patch cable to the Ethernet Network port on the back of the AlcoTest™.
- 2) Connect the other end of the patch cable top an appropriate network port on your network.

---

*If you do not know if a particular network port is correct or appropriate for connection to the AlcoTest™ unit **STOP** and consult with your local network administrator or IT department.*



***IT IS NOT RECOMMENDED TO ATTEMPT TO CONNECT THE AlcoTest™ TO A NETWORK PORT UNLESS IT IS PROPERLY CONFIGURED!***

*Connecting to a misconfigured network port or a port that 'looks' like a network port but may be for example a local telephone port may cause damage to your network or to the AlcoTest™ unit.*

*WHEN IN DOUBT – **STOP** – and consult the proper personnel within your organization.*

---

- 3) Follow the Basic Steps as given in section 10.1
- 4) Select **Control Panel** from the AlcoTest™ AlcoTest™ Control menu
- 5) Once in the control panel select the Windows Explorer Icon as shown below.



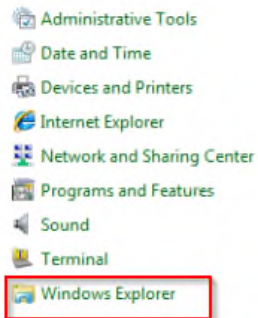


Figure 10.40 – Open Windows Explorer

- 6) Click the Computer Icon on the Left hand side of the screen.

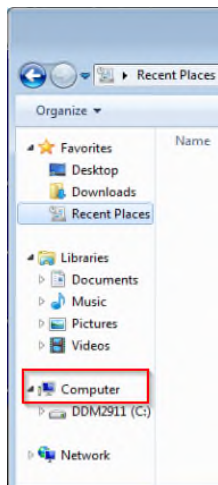
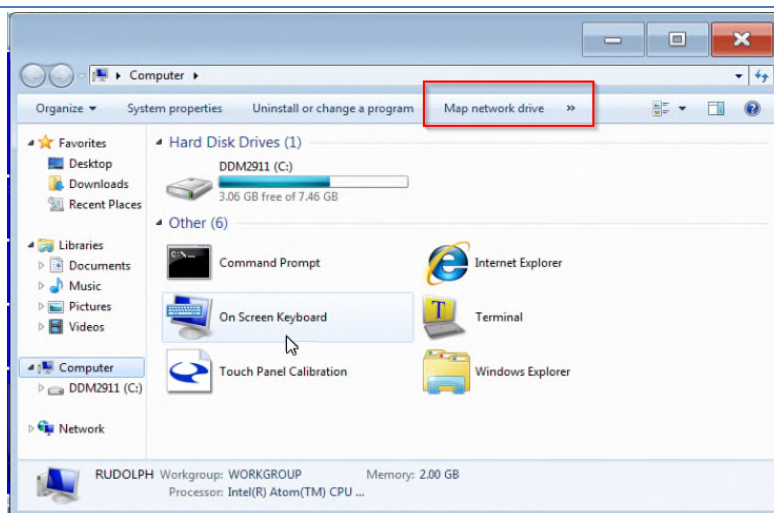


Figure 10.41 – Open Computer

- 7) A screen similar to Figure 10.42 below should be displayed. Select Map Network Drive at the top of the screen.



*Figure 10.42 – Mapping the Network Drive*

- 8) Select the drive letter to assign to the network drive and enter the name of the network share. You may need to ask your Network Administrator for the network share name.

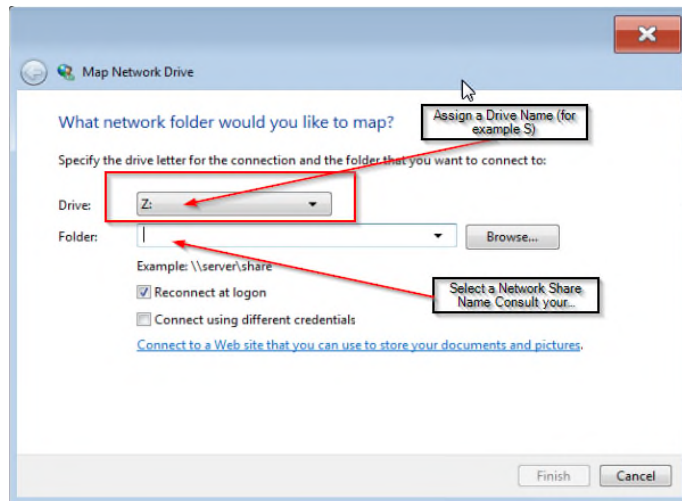


Figure 10.43 – Choosing the local drive designation

- 9) Click on **Connect using different credentials**. Enter the user name and password of someone who has permission to access the network share and click **OK**.

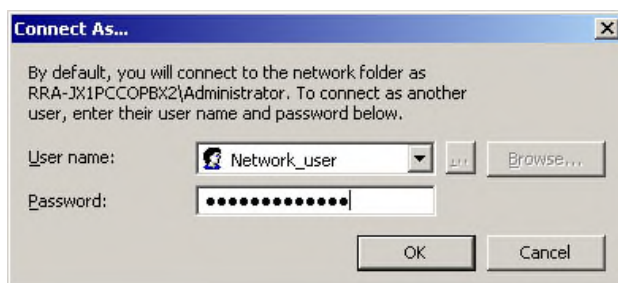


Figure 10.45 – Connecting using Username and Password

- 10) Click **Finish**.
- 11) Close the Control Panel window by clicking the X in the top right hand corner of the windows. This will return you to the AlcoTest™ Control

menu. Select **Turn Disk Protection On**. The system will display a message that the AlcoTest™ will restart. Click Yes to continue.



---

*This information is intended for the IT support personnel. Under certain instances the AlcoTest™ may not remember the User name and Password combination used to map to the network drive. This can be overcome by using the Windows NET USE command. Perform the following actions:*

---

- 1) Turn off the AlcoTest™'s Disk Protection (shown in steps 2 – 7).
- 2) Enter the Windows Embedded Control Panel (shown in steps 8 – 11).
- 3) In the Control Panel address bar enter C:\Windows\System32\cmd.exe to bring up the command window.
- 4) At the command prompt type:
  - NET USE y: \\server\_name\share\_name /savecred /persistent:yes
  - Where:
    - y: is the drive letter you want to map the share to.
    - server\_name is the name of the server the share resides on
    - share\_name is the name of the share you are mapping to
    - /savecred will save the user credentials to be used to access the network share. **NOTE:** Access the mapped drive while still in control panel. The system will prompt you for the user credentials. Enter the credentials this one time and the system will remember the user credentials.
    - /persistent:yes will make the mapping persist even with a system power down.
- 5) You will then be prompted to input the User Name and Password to be used to access the network share.

6) Turn disk protection back on and reboot the system.

After the system restarts, the AlcoTest™ contains the mapping to the network share.

## 10.5 Importing/Exporting the Configuration Settings

### 10.5.1 Exporting the Configuration Settings

- 1) Enter the menu by pressing the **Menu** button. If required enter your password in the dialog. Select **Operational Parameters** from the menu

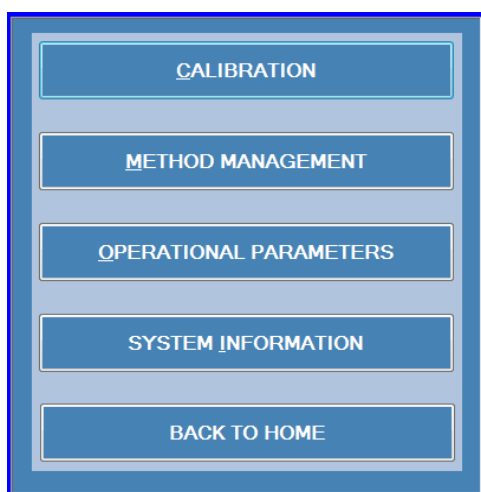


Figure 10.46 – Operational Parameters Menu

- 2) Select **Instrument Configuration** from the **Operational Parameters** menu.

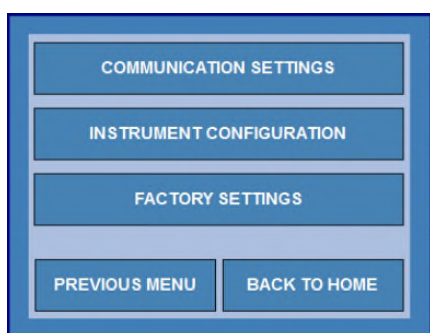


Figure 10.47 – Instrument Configuration



- 3) Select the **Service/Data** button from the Instrument Specific Menu

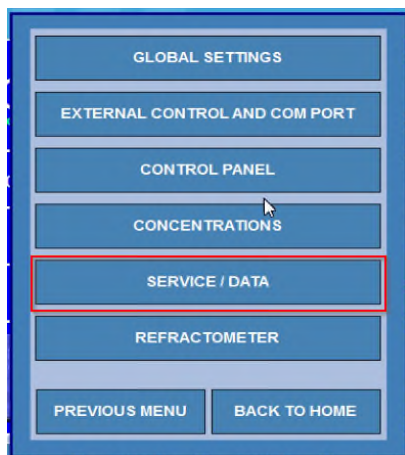


Figure 10.48 – Service / Data

- 4) Select **Backup and Restore** from the Instrument Configuration menu.  
Then select **Configuration Settings**

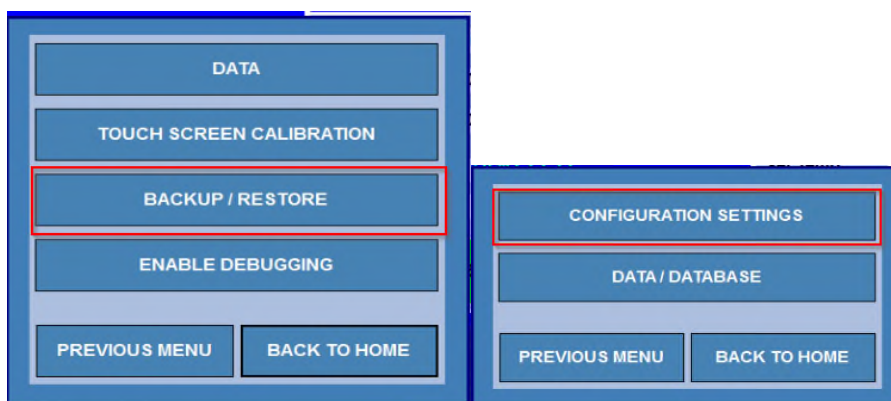


Figure 10.49 – Backup/Restore Configuration

- 5) Select **Backup Configuration Settings** from the Configuration Settings menu.

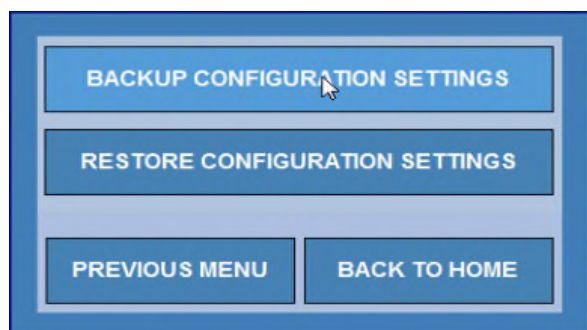


Figure 10.50 – Backup Configuration Menu

- 6) When the Backup is complete the following screen will display.

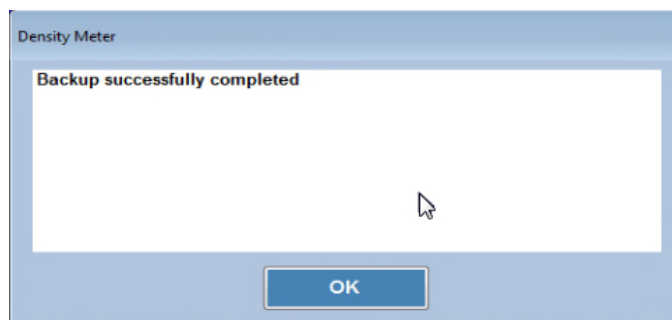


Figure 10.51 – Backup completed

## 10.5.2 Restoring the Configuration Settings

- 1) Enter the menu by pressing the menu button (see figure 10.65 above). Navigate the menus to the **Menu > Operational Parameters > Instrument Configuration > Backup/Restore > Configuration Settings** menu.
- 2) Click the **Restore Configuration Settings** button.

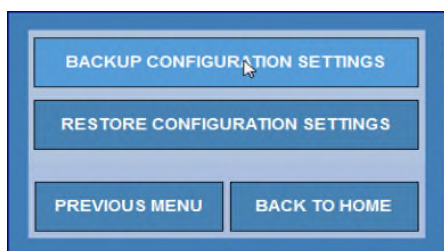


Figure 10.52 – Restore Configuration

- 3) The following dialog will open displaying all of the saved configfiles organized by Date and Time. Highlight the configuration you wish to restore and click the **RESTORE** button.

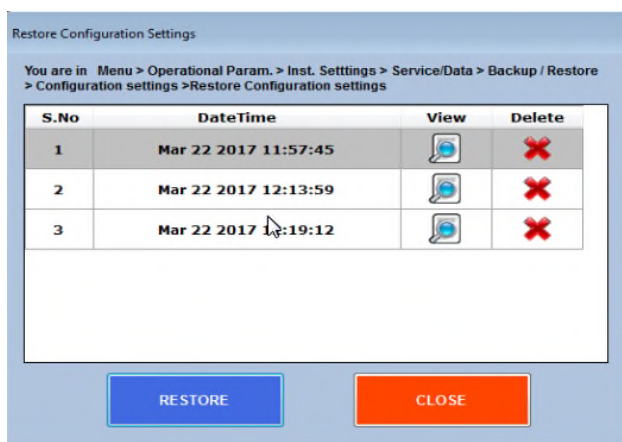



Figure 10.52 – Restore older configuration

- 4) Optionally you may view the stored configuration and verify that you wish to restore it prior to pressing **Restore**. To view a stored configuration click the  icon in the View column. The following dialog will display.

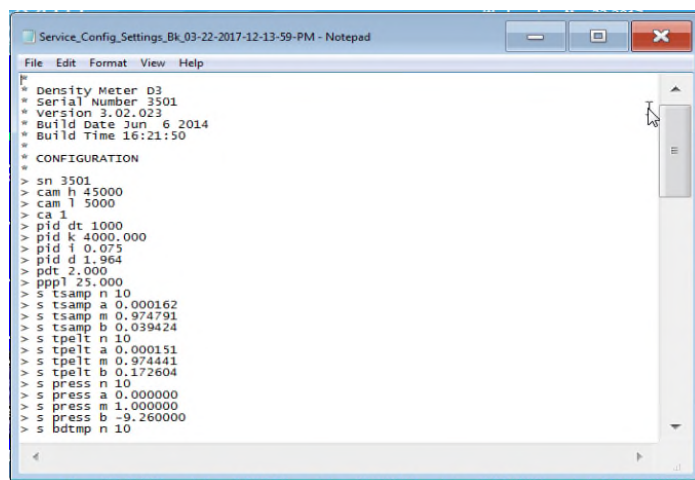


Figure 10.53 – Configuration file

- 5) After the configuration settings have been restored you will see the screen shown in figure 10.54 below. Click the **OK** button. The restore is finished.

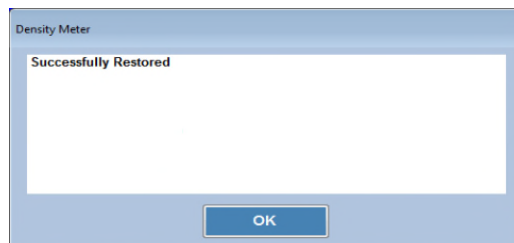


Figure 10.54 – Restoration success

## 10.6 Importing/Exporting the Database Settings

### 10.6.1 Exporting the Configuration Settings

- 7) Enter the menu by pressing the **Menu** button. If required enter your password in the dialog. Select **Operational Parameters** from the menu

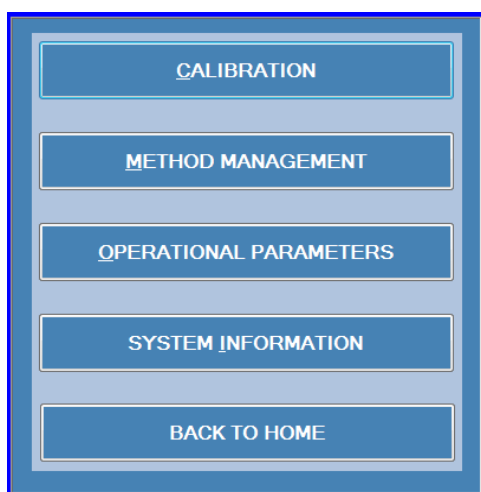


Figure 10.55 – Operational Parameters

- 8) Select **Instrument Configuration** from the **Operational Parameters** menu.

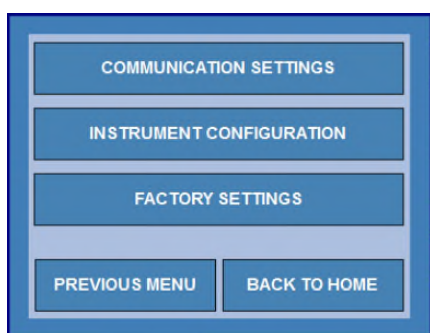


Figure 10.56 – Instrument Configuration

- 9) Select the **Service/Data** button from the Instrument Specific Menu

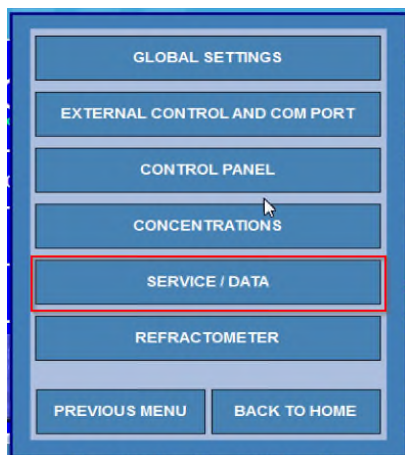


Figure 10.57 – Service / Data

- 10) Select **Backup and Restore** from the Instrument Configuration menu.  
Then select **Configuration Settings**

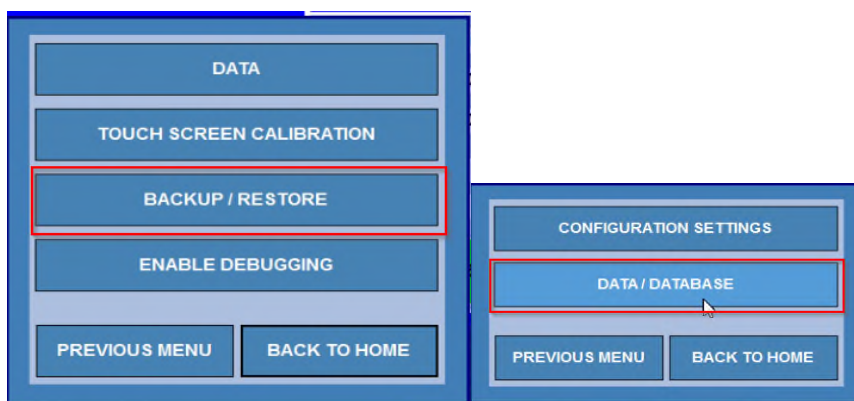


Figure 10.57 – Data/Database Configuration Settings



The following menu will be displayed.

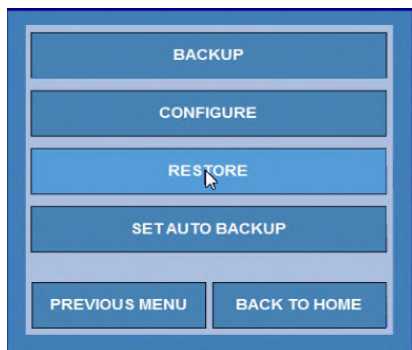


Figure 10.59 – Configuration Menu

From this point the user has the option to set the place where Database Backups will be saved as well as either Backup or Restore the Database. The Set Auto Backup button allows the user to configure a regular snapshot of the system database to be saved to the Backup folder.

Each option will be described in the following sections.

### 10.6.3 Configuring the Database Backup Folder

From the menu above click the **Configure** button. The following dialog will display.

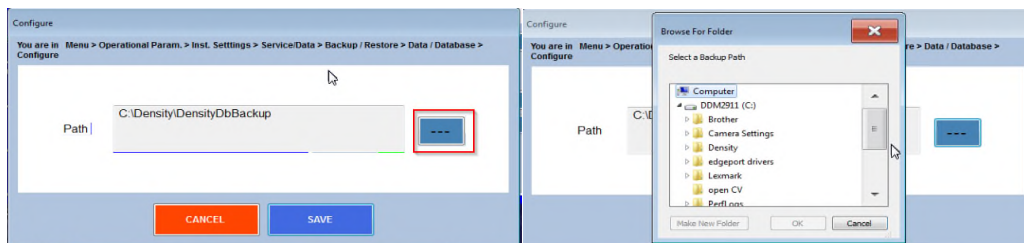


Figure 10.60 – Config Database Backup

The default database backup folder is shown. The user may chose a different folder using the browse button (highlighted in the red box). This allows the user to pick a location on either a networked storage drive or a removable USB thumb drive. The Database can thereby be backed up in a location that is secure or protected as needed.

## 10.6.4 Backing up the Database

Once the user has configured the location for storing the database backup, or possibly using the default location, the **Backup** button may be pressed to perform the backup.

The following screen is displayed: The current location is shown and the user is given the option to **Backup** or **Cancel**.

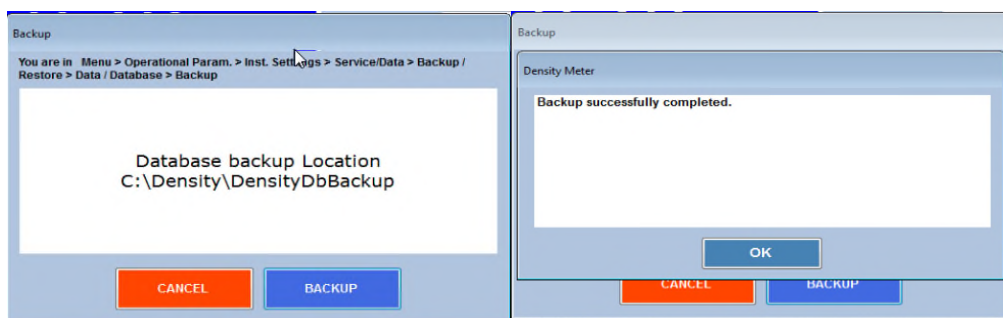


Figure 10.62 – Backing up the Database

Pressing the Backup button shows the confirmation screen.

## 10.6.5 Setting up the Auto Backup Schedule for the Database

Optionally the user may desire to have a regular backup of the database performed on a schedule. To configure this option, press the **Set Auto Backup** button. The following menu is displayed.

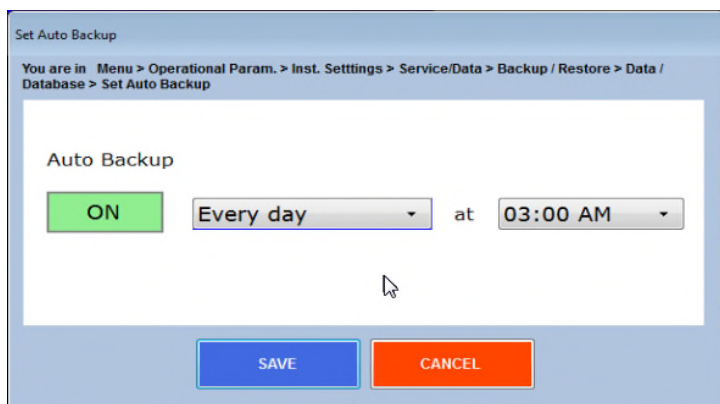


Figure 10.64 – Backup Settings configuration

The user can select the frequency of backups in the drop-down menus as well as the time of day that the backup is to run. The folder that the backup is stored to must be available, so the network drive or external drive must be connected to the unit in order to perform this type of unattended backup.

### 10.6.6 Restoring the Database

- 1) Enter the menu by pressing the menu button (see figure 10.65 above). Navigate the menus to the **Menu > Operational Parameters > Instrument Configuration > Backup/Restore > Database Settings** menu.
- 2) Click the **Restore** button.

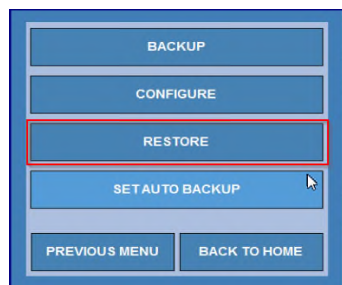


Figure 10.65 – Restoring a Database

- 3) The following dialog will open displaying all of the saved database files organized by Date and Time. Highlight the configuration you wish to restore and click the **RESTORE** button.

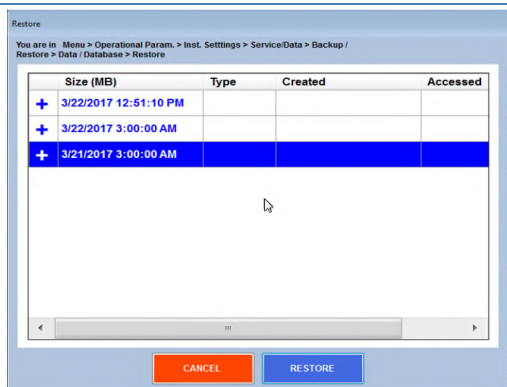


Figure 10.66 – Restoring the Backed Up Database

The following confirmation screen will display.

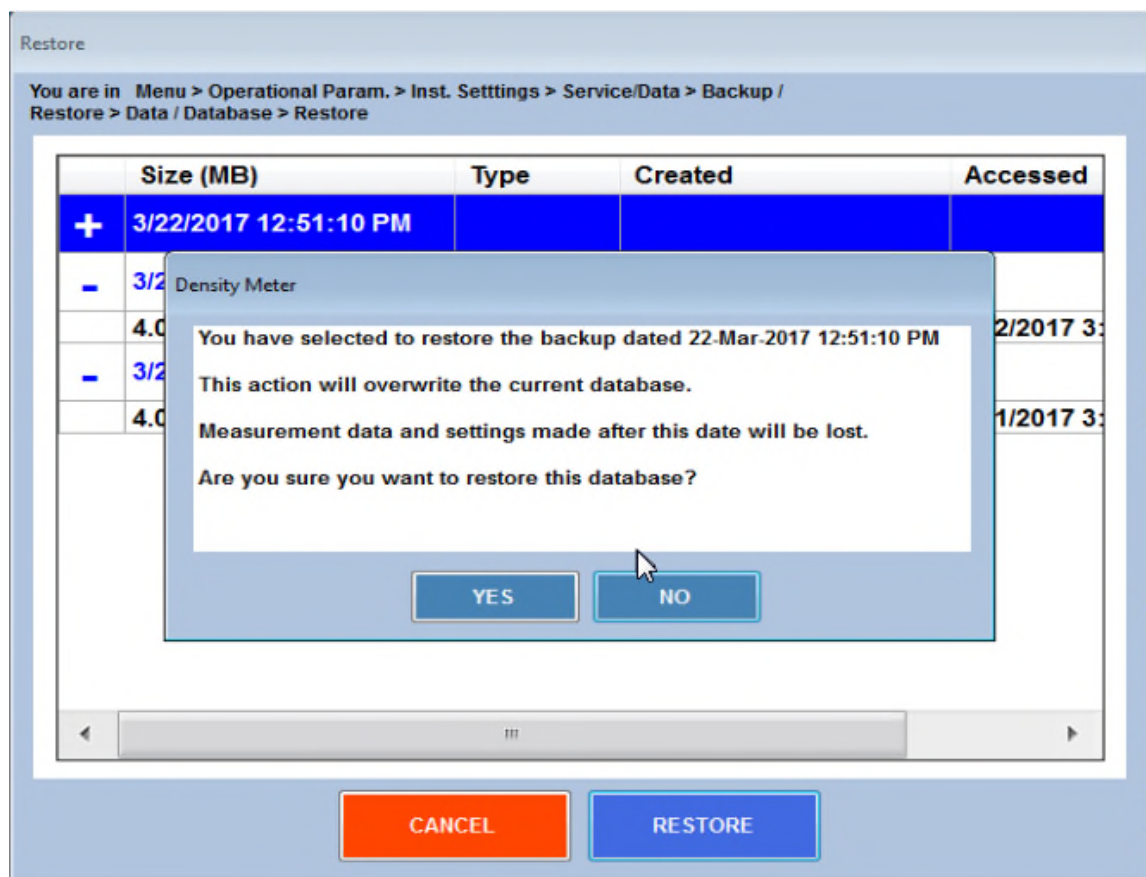


Figure 10.67 – Selecting the Database to Restore

Pressing **YES** will restore the selected database to the unit.



---

*NOTE: restoring a database will result in the LOSS of any measurement data that was performed since the last backup. Please consult RRA support personnel or your local instrument admin before restoring to an earlier copy of the unit database.*

---

## 11. Factory Testing – QC – Electronic Copy of Manual

A variety of menus and information is available on the AlcoTest™ to assist with confirming proper documentation.

### 11.1 System Information

To learn the instrument's Serial Number, Software and Firmware Versions:

Select **Menu** from the Main Screen > Select **System Information**

A Window, similar to the following, will open providing all this information.



Figure 11.1 - System information

To view an electronic copy of this manual click the Manual button in figure 11.1



## 11.2 QC Procedure at Factory IQ/OQ/PQ

From the Method Management option you can select “Factory QC Testing” method and then select “RESULTS”. You will get a window similar to the Figure 11.2.

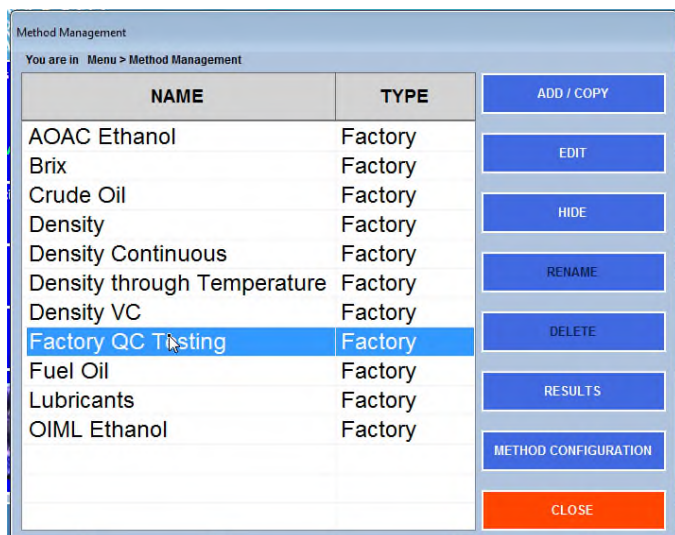


Figure 11.2 - Factory QC Results

All measurement results can be viewed within this Method. This is a Read Only Document and cannot be deleted or altered.

## 11.3 Electronic Copy of User’s Manual

As can be seen in Figure 11.1 above a electronic copy of the User’s Manual is also available. From that Window select **Manual**.

There is also a F.A.Q section that may also be found with the **Help** button located in the upper right of the main screen.

The following Window will open as shown in Figure 11.3.



Figure 11.3 – Digital Copy of User Manual – local unit



*Just click on the topic or chapter of interest and the program will immediately jump to that area.*

HINT

## 11.4 Help

Access to Help is from the Main Screen in the upper right-hand corner. When you push Help, you will see a window as shown in Figure 11.5.

Within Help you may find the User's Manual, Contact names, phone numbers and email addresses.

There is also information about a remote desktop sharing program; TeamViewer™. This software permits both training of operators as well as troubleshooting done at remote location.

The most frequently asked questions regarding the measurements and applications of the AlcoTest™ 2910 and AlcoTest™ 2911 are answered here and you may gain access by clicking on any topic of your interest

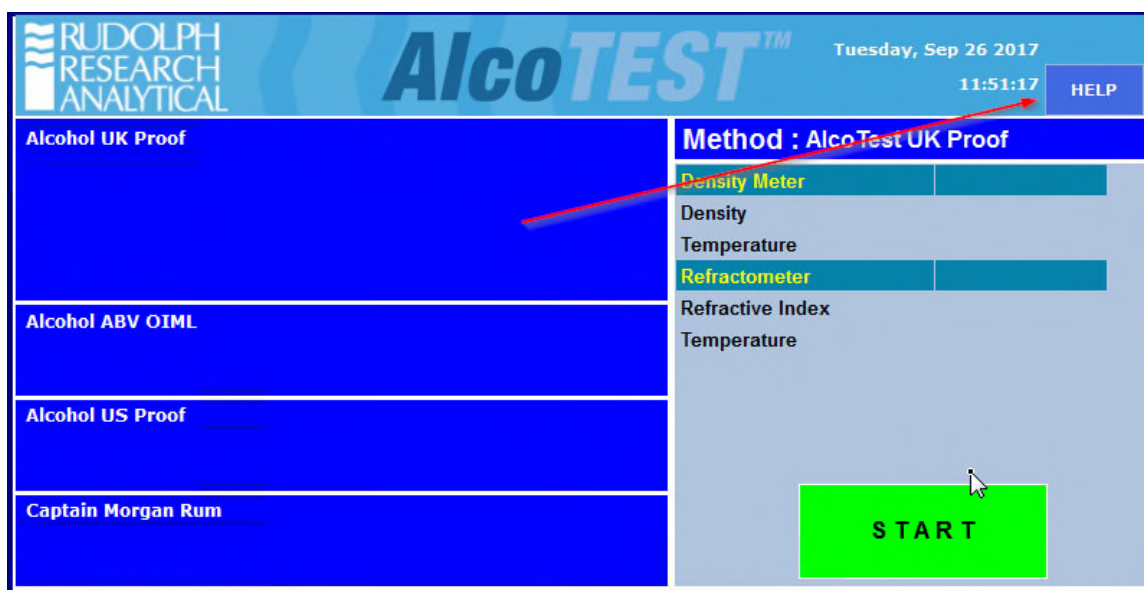


Figure 11.5 – Help Button

The Help Screen will display as shown.

## 12. Understanding Density and Specific Gravity

### 12.1 Definitions

Density is the mass of a material divided by its volume. Some of the most commonly used units for density include: grams/cubic centimeter (g/cm<sup>3</sup>), grams/milliliter (g/ml), kilograms/cubic meter (kg/m<sup>3</sup>), and pounds /gallon (lbs/gal).

While a material's mass does not change as a function of temperature, its volume does. Therefore, a material's density is a function of temperature. It is necessary to always include temperature with any description of density.

Density is often shown in the literature as the Greek letter rho,  $\rho$ .

Specific Gravity, sometimes called Relative Density, is a dimensionless value that is the quotient of two density values. In its most basic form it may be expressed as:

$$SG_{t1/t2} = \frac{\text{Density of the material being measured at some temperature } t1}{\text{Density of some reference material (usually water) at some temperature } t2}$$

Temperature t1 does NOT have to be equal to temperature t2, that is;  $t1 \neq t2$

For example:  $SG_{\frac{20^{\circ}\text{C}}{4^{\circ}\text{C}}}$ , or  $SG_{\frac{20^{\circ}\text{C}}{60^{\circ}\text{F}}}$  (See Chapter 6 page 31 for more details on t1 & t2)

Therefore, it is best to always indicate the temperature in both the numerator and denominator when describing Specific Gravity.

Unfortunately, this is not always done. It is common to hear or read descriptions of SG at only one temperature. That is, the SG at 20 °C or SG at 60 °F. If this is all the information given, one can only assume that the temperature in the numerator and denominator are the same. But assume this with some caution.

When temperature t1 equals temperature t2 the SG of water is always 1.00000, at all temperatures. Let's look at the example below to understand why this is so.

The Density of pure water at 20 °C is 0.99820 g/cm<sup>3</sup> and the Density of pure water at 25 °C is 0.99704 g/cm<sup>3</sup>

If in the SG equation,  $t_1 = t_2$ , and if the reference material is water then,

At 20°C:

$$SG_{t_1}^{t_2} = SG_{20^\circ C}^{20^\circ C} = \frac{0.99820 \text{ g/cm}^3}{0.99820 \text{ g/cm}^3} = 1.0000$$

and,

At 25°C:

$$SG_{t_1}^{t_2} = SG_{25^\circ C}^{25^\circ C} = \frac{0.99704 \text{ g/cm}^3}{0.99704 \text{ g/cm}^3} = 1.0000$$

Note that the units of density cancel each other out; thereby leaving SG as a dimensionless unit of measure. Also, it should be apparent that whenever  $t_1=t_2$  that the SG of water will be 1.0000 at all temperatures.

#### Apparent Density and Apparent Specific Gravity

In the discussion above, we only considered “true” density and “true” specific gravity, which are measurements related to mass of the material. Apparent Density and Apparent Specific Gravity are functions not of mass, but of weight.

That is, Apparent Density is the weight of a material divided by its volume. And, Apparent Specific Gravity is the Apparent Density of a material divided by the Apparent Density of some reference material (again, usually water).

As in the discussion above, temperature must always be defined.

Mass is a constant independent of an object's position. Weight, however, is a function of gravitational force. Subsequently, one's mass is identical on the earth and the moon, but one's weight is completely different.

The difference between True Density and Apparent Density can be shown easily by looking at the densities of air.

We know that air is made up of mostly Nitrogen and Oxygen. Therefore air has mass and we would expect air to have a density value.

The true density of dry air at 20 °C at 1 atmosphere is 0.00120 g/cm<sup>3</sup>

But you cannot weigh air on a balance; the Apparent Density of air is 0.00000 g/cm<sup>3</sup>.

## **12.2 The Mechanical Oscillation Principle – A Brief Explanation**

In the most simplistic of terms, the glass U-tube (the sample cell) acts like a tuning fork. The tuning fork always yields a reproducible harmonic oscillation; that is, always giving off the same exact tone or note similar to a piano key, it always strikes the same string the same way and yields the same note each time. The tuning fork and the piano string are examples of objects vibrating at their natural or harmonic frequency. Imagine, however, that the tuning fork was hollow or was a capillary tube. It will again yield some reproducible frequency of oscillation or tone. But if we now fill that tube with water, the tone will become lower and the time required for a cycle of oscillation to happen is now longer. That is, the period (time) has now increased by adding mass to the inside of that hollow capillary tube. As it turns out, the period of oscillation is directly proportional to the increase in mass inside the vibrating oscillator.

The nature of the frequency or period depends upon the mass and subsequently the density of the materials filling the oscillator.

Through use of a piezo-electronic system, the hollow U-tube inside the Automatic AlcoTest™ is caused to vibrate at its natural resonance frequency, much like the tuning fork example above. At a constant temperature, this harmonic frequency is a constant and a reproducible value.

The U-tube is then filled with the sample which is also controlled to the same constant temperature. The frequency of the U-tube will shift; the shift in this frequency is indirectly proportional to the mass of the sample inside the U-tube. We now have a measurable frequency that indicates mass and we have a constant volume U-tube, acting somewhat like a pycnometer. With mass and volume, we now have all that is required for a very accurate and reproducible density measurement.



### **13. Operator Safety and Proper Equipment Operation**

The AlcoTest™ line of laboratory grade AlcoTest™s have been designed with full safety of the operator in mind. The units are UL and CE approved for use in a laboratory or office environment. There are important considerations when using any type of laboratory equipment that should be observed so as to prevent the operator from accidental injury. In this section the proper precautions and recommended safety equipment will be outlined.

#### **OSHA Standards**

Rudolph Research recommends that customers conform their safety and operational standards and practices to the best practices recommended by OSHA and/or similar government safety bodies. The relevant standard falls under the OSHA 3404-11R 2011 document.

Rudolph Research recommends that operators of our equipment and similar types of laboratory equipment familiarize themselves with this standard. The standard is freely available from the OSHA website:

<https://www.osha.gov/Publications/laboratory/OSHA3404laboratory-safety-guidance.pdf>

#### **Chemicals & Test Liquids**

The AlcoTest™ series of laboratory AlcoTest™ equipment have been designed to accommodate a wide range of both polar and non-polar types of liquid solvents and test liquids. It is well known that certain types of liquids present workplace hazards, both to exposed skin, eyes and mucous membranes.

It is assumed that best practices are in place to guard against noxious exposure to these types of liquids. For a list of chemicals and test liquids that require special caution when in use with the Rudolph Research AlcoTest™ equipment please see table F.1 below. This is not intended to be an exhaustive list.

Table F.1

CHEMICAL	COMMENTS
<b>SODIUM HYDROXIDE NAOH</b>	Strong caustics especially at higher temperatures can etch the glass of the U-tube. When making measurements of Sodium Hydroxide it is recommended not to do so above 20°C and not to remain inside the glass U-tube for any extended period of time. Rinse immediately after measurement is completed.
<b>HYDROFLUORIC ACID - HF</b>	Not to be used at all as HF etches glass very quickly!
<b>SULFURIC ACID H<sub>2</sub>SO<sub>4</sub></b>	The silicone waste hose is not compatible with sulfuric acid. Use Viton tubing instead. Also, be cautious concerning the exothermic reaction between the acid and a water rinse.

If you have any questions as to the proper use of any solvent or test liquid in conjunction with either cleaning or testing with Rudolph Research AlcoTest™ equipment, please contact the factory directly.

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E-Mail: [info@rudolphresearch.com](mailto:info@rudolphresearch.com)

## **Eye protection**

Rudolph Research recommends that all operators wear proper protective eye gear when using or cleaning the AlcoTest™ series of AlcoTest™ equipment. All eye protection devices should meet or exceed ANSI Standard Z87.1 – available from ANSI here:

<http://webstore.ansi.org/Cart.aspx?Action=AddProduct&Catalog=ESSCatalog&ProductID=ANSI%2fISEA+Z87.1-2015>

## **Electrical Protection**

Rudolph Research equipment is designed to accept a wide range of mains power. The units will work with AC power from 100VAC to 240VAC. Operators should be cautious when installing or moving the equipment and always make use of the cord provided with the equipment to connect it to a properly grounded and electrically safe mains power connection.

It is not required but it is desirable that the equipment be connected to the mains via a GFCI (Ground Fault Circuit Interruption) type system. GFCI outlets are recommended in any environment where the operator or the equipment is exposed to ambient moisture as a part of normal operation.

Care should be exercised when connecting or reconnecting the unit to the mains or when shutting the power to the unit on or off.

The AlcoTest™ system is UL tested and approved for electrical safety under normal operation.

## **Skin/Hand and Personal Protection**

Operators should use appropriate skin, hand and personal protection, as per the relevant OSHA standards for the liquids, solvents and test materials being used. Certain types of solvents may be absorbed through unprotected skin or cause chemical burns or damage.

Appropriate protective gear and clothing that meets or exceeds OSHA standard 3151-12R 2004 should be employed when making use of the AlcoTest™ system. The OSHA standard can be downloaded here:

<https://www.osha.gov/Publications/osh3151.pdf>

## **Static Electrical Discharge**

The AlcoTest™ system is designed to accept normal levels of ESD (Electro-Static Discharge) without affecting operation. Users are not required to use anti-static protective gear to operate the AlcoTest™ system.

It is however recommended that users guard against electro-static discharge when employing any types of flammable solvents or test liquids in conjunction with the AlcoTest™ system. Flammable liquids may be ignited in the presence of electro-static discharges and thereby present a fire hazard.

It is further recommended that appropriate fire safety measures be in place at the customer site. These should comply with or exceed local fire safety regulations.

## **Heat and Hot Surfaces**

The AlcoTest™ system has been designed with operator safety in mind. As a function of normal operation some parts of the AlcoTest™ system are designed to heat up and may become uncomfortably hot to the unprotected touch.

Care should be taken when operating or cleaning all parts of the AlcoTest™ system.

The maximum operating temperature specifications system may approach 100 °C – care should be exercised when using any part of the system which is intended to heat or temperature control samples.

## **Internal Components**

There are no user serviceable internal components within the AlcoTest™ system. Users are cautioned to not access the internal components of the AlcoTest™ system as there is a risk of shock or damage to the equipment. All internal service and maintenance required to be performed on the AlcoTest™ system must be performed by a qualified authorized Rudolph Research technician or support engineer.

## **Liquid Spills and Cleaning**

The AlcoTest™ system is designed to be very tolerant to liquid spills. The Touch Screen is both liquid and soil resistant and its designed to work in a wide variety of environments without issues. Regardless users should be careful not to spill excessive amounts of liquids into the touch screen.

The AlcoTest™ system is also designed to be easily cleaned. Normal cleaning solvents, such as are employed in standard laboratory bench cleaning, are most likely fine for use with the AlcoTest™ system. External cleaning may be done on a regular basis by maintenance and janitorial staff with proper normal care.

## **Flammable Liquids**

- NOTE: When using inflammable liquids near the equipment or for testing or cleaning purposes please follow the following precautions.
- Do not store flammable material near the equipment. This included materials which may contribute to the severity of an incident, such as lab coats, packing material or papers.
- Do not leave flammable sample containers or solvent containers uncovered.
- Spillage of flammable solvents, samples and or cleaning materials should be addressed immediately. Please do not operate the equipment in the event of a nearby flammable liquid spillage.
- Ensure adequate ventilation if the AlcoTest™ is to be used with noxious and/or flammable liquids or solvents.
- Follow best practices with regards to the connection of this equipment to the mains power when used with flammable liquids. It is recommended that the local fire safety ordinances be consulted and that all required fire safety inspections be conducted prior to operation of the equipment in a flammable liquid environment.
- Fire extinguishing equipment and/or fire suppression equipment as required by local ordinances or fire safety codes, should be installed and operators should be familiar with their operation prior to using this equipment in a flammable liquid environment.
- Never leave the equipment unattended when it is operated in an environment where flammable liquids are present.

## **Explosion Proof Standards**

The AlcoTest™ unit is not designed to meet the UL1203 standard for explosion proof equipment. This means that the unit has not been rigorously tested to ensure that it will not be a source of ignition in explosive or flammable atmospheres or environments. Please refer to the relevant standard from UL here: [http://ulstandards.ul.com/standard/?id=1203\\_5](http://ulstandards.ul.com/standard/?id=1203_5)

Rudolph Research does not recommend that the AlcoTest™ unit be used in any environment that requires UL1203 certification.

### **Bio Hazards**

The AlcoTest™ system is not designed to guard against bio hazardous materials. In the event that biohazardous materials are used for either testing or cleaning the system it is the responsibility of the end user to take all appropriate steps to ensure safety as well as contain any possible exposure vectors.



## Appendix A – Technical Specifications

	DDM 2909	DDM 2910	DDM 2911	DDM 2911 PLUS
<b>Accuracy</b>	Density: 0.0002 g/cm <sup>3</sup> Temperature: 0.05 °C	Density: 0.0001 g/cm <sup>3</sup> Temperature: 0.05 °C	Density: 0.00005 g/cm <sup>3</sup> Temperature: 0.03 °C	Density: 0.00001 g/cm <sup>3</sup> Temperature: 0.01 °C
<b>Repeatability</b>	Density: 0.0001 g/cm <sup>3</sup> Temperature: 0.02 °C	Density: 0.00005 g/cm <sup>3</sup> Temperature: 0.02 °C	Density: 0.00001 g/cm <sup>3</sup> Temperature: 0.01 °C	Density: 0.000005 g/cm <sup>3</sup> Temperature Selectable: 0.001 °C
<b>Resolution</b>	Density: 0.0001 g/cm <sup>3</sup> Temperature: 0.01 °C	Density: 0.0001 g/cm <sup>3</sup> Temperature: 0.01 °C	Density: 0.00001 g/cm <sup>3</sup> Temperature: 0.01 °C	Density: 0.000001 g/cm <sup>3</sup> Temperature Selectable to: 0.001 °C
<b>Density Ranges</b>	0 to 3 g/cm <sup>3</sup>			
<b>Temperature Range</b>	0 °C to 95°C (controlled via Peltier)			
<b>Pressure</b>	0 to 10 bars			
<b>Video Scanning &amp; Magnification</b>	Three magnified video assisted views of the entire cell are available, in 2x, 6x and a 10x magnifications with video scanning. Images maybe saved with results for subsequent review.			
<b>Automatic Bubble Detection</b>	Automatically warns operator of bubbles			
<b>Measurement Modes</b>	Continuous, Single, Multiple			
<b>Measurement Technique</b>	Mechanical Oscillating U-Tube Method			
<b>Minimum Sample Volume</b>	Less than 1mL			
<b>Wetted Materials</b>	Borosilicate glass, Teflon PTFE ECTFE			
<b>Operating Systems</b>	Windows Embedded; write protected software safe from malware and viruses			
<b>Measurement Time:</b>	30 - 60 seconds after thermal equilibration			
<b>Display</b>	10.4 inch diagonal TFT type LCD with wide viewing angle, anti-glare flat panel touch screen, 300 nits brightness, 800 x 600 pixels, chemical, scratch and spill resistant monitor, the industry's largest and most flexible interface			
<b>Communication Interface</b>	Touch Screen User Interface, 5 – USB Ports, 2 – RS232 Ports, Ethernet Port for Network Connection, Keyboard Bar Code Scanner, Mouse, Network Capabilities			
<b>Remote Support</b>	Trouble shooting, Diagnostics, Software Updates available via the Internet			
<b>Internal Memory</b>	32 GB Non-removable Compact Flash			
<b>Operating Dimensions</b>	18.36" (L) x 11.80" (W) x 13.90" (H) 46.61 cm (L) x 29.97 cm (W) x 35.30 cm (H)			
<b>Shipping Dimensions and Weight</b>	24.5" (L) x 17.5" (W) x 22" (H) 62cm (L) x 44cm (W) x 56cm (H)			
<b>Shipping Weight</b>	50 lbs. (23kg)			
<b>Power Supply</b>	85 to 260 VAC; 48 to 62 Hz			
<b>Power Consumption</b>	140 Watts at peak			
<b>Origin of Manufacture and Design</b>	USA			

## Appendix B – Water Density Table

°C	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	0.999840	0.999846	0.999853	0.999859	0.999865	0.999871	0.999877	0.999883	0.999888	0.999893
1	0.999899	0.999903	0.999908	0.999913	0.999917	0.999921	0.999925	0.999929	0.999933	0.999937
2	0.999940	0.999943	0.999946	0.999949	0.999952	0.999954	0.999956	0.999959	0.999961	0.999962
3	0.999964	0.999966	0.999967	0.999968	0.999969	0.999970	0.999971	0.999971	0.999972	0.999972
4	0.999972	0.999972	0.999972	0.999971	0.999971	0.999970	0.999969	0.999968	0.999967	0.999965
5	0.999964	0.999962	0.999960	0.999958	0.999956	0.999954	0.999951	0.999949	0.999946	0.999943
6	0.999940	0.999937	0.999934	0.999930	0.999926	0.999923	0.999919	0.999915	0.999910	0.999906
7	0.999901	0.999897	0.999892	0.999887	0.999882	0.999877	0.999871	0.999866	0.999860	0.999854
8	0.999848	0.999842	0.999836	0.999829	0.999823	0.999816	0.999809	0.999802	0.999795	0.999788
9	0.999781	0.999773	0.999766	0.999758	0.999750	0.999742	0.999734	0.999725	0.999717	0.999708
10	0.999699	0.999691	0.999682	0.999672	0.999663	0.999654	0.999644	0.999635	0.999625	0.999615
11	0.999605	0.999595	0.999584	0.999574	0.999563	0.999553	0.999542	0.999531	0.999520	0.999508
12	0.999497	0.999486	0.999474	0.999462	0.999450	0.999438	0.999426	0.999414	0.999402	0.999389

13	0.999377	0.999364	0.999351	0.999338	0.999325	0.999312	0.999298	0.999285	0.999271	0.999258
14	0.999244	0.999230	0.999216	0.999202	0.999187	0.999173	0.999158	0.999144	0.999129	0.999114
15	0.999099	0.999084	0.999069	0.999053	0.999038	0.999022	0.999006	0.998991	0.998975	0.998959
16	0.998942	0.998926	0.998910	0.998893	0.998876	0.998860	0.998843	0.998826	0.998809	0.998792
17	0.998774	0.998757	0.998739	0.998722	0.998704	0.998686	0.998668	0.998650	0.998632	0.998613
18	0.998595	0.998576	0.998558	0.998539	0.998520	0.998501	0.998482	0.998463	0.998443	0.998424
19	0.998404	0.998385	0.998365	0.998345	0.998325	0.998305	0.998285	0.998265	0.998244	0.998224
20	0.998203	0.998182	0.998162	0.998141	0.998120	0.998099	0.998077	0.998056	0.998035	0.998013
21	0.997991	0.997970	0.997948	0.997926	0.997904	0.997882	0.997859	0.997837	0.997815	0.997792
22	0.997769	0.997747	0.997724	0.997701	0.997678	0.997654	0.997631	0.997608	0.997584	0.997561
23	0.997537	0.997513	0.997490	0.997466	0.997442	0.997417	0.997393	0.997369	0.997344	0.997320
24	0.997295	0.997270	0.997246	0.997221	0.997196	0.997170	0.997145	0.997120	0.997094	0.997069
25	0.997043	0.997018	0.996992	0.996966	0.996940	0.996914	0.996888	0.996861	0.996835	0.996809
26	0.996782	0.996755	0.996729	0.996702	0.996675	0.996648	0.996621	0.996594	0.996566	0.996539
27	0.996511	0.996484	0.996456	0.996428	0.996400	0.996373	0.996344	0.996316	0.996288	0.996260
°C	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9

28	0.996232	0.996203	0.996174	0.996146	0.996117	0.996088	0.996059	0.996030	0.996001	0.995972
29	0.995943	0.995913	0.995884	0.995854	0.995825	0.995795	0.995765	0.995735	0.995705	0.995675
30	0.995645	0.995615	0.995584	0.995554	0.995523	0.995493	0.995462	0.995431	0.995401	0.995370
31	0.995339	0.995307	0.995276	0.995245	0.995214	0.995182	0.995151	0.995119	0.995087	0.995056
32	0.995024	0.994992	0.994960	0.994928	0.994895	0.994863	0.994831	0.994798	0.994766	0.994733
33	0.994700	0.994667	0.994635	0.994602	0.994569	0.994535	0.994502	0.994469	0.994436	0.994402
34	0.994369	0.994335	0.994301	0.994268	0.994234	0.994200	0.994166	0.994132	0.994097	0.994063
35	0.994029	0.993994	0.993960	0.993925	0.993891	0.993856	0.993821	0.993786	0.993751	0.993716
36	0.993681	0.993646	0.993610	0.993575	0.993540	0.993504	0.993468	0.993433	0.993397	0.993361
37	0.993325	0.993289	0.993253	0.993217	0.993181	0.993144	0.993108	0.993072	0.993035	0.992998
38	0.992962	0.992925	0.992888	0.992851	0.992814	0.992777	0.992740	0.992703	0.992665	0.992628
39	0.992591	0.992553	0.992515	0.992478	0.992440	0.992402	0.992364	0.992326	0.992288	0.992250
40	0.992212	0.992174	0.992135	0.992097	0.992058	0.992020	0.991981	0.991942	0.991904	0.991865
41	0.991826	0.991787	0.991748	0.991708	0.991669	0.991630	0.991590	0.991551	0.991511	0.991472
42	0.991432	0.991392	0.991353	0.991313	0.991273	0.991233	0.991193	0.991152	0.991112	0.991072
43	0.991031	0.990991	0.990950	0.990910	0.990869	0.990828	0.990787	0.990747	0.990706	0.990665

44	0.990623	0.990582	0.990541	0.990500	0.990458	0.990417	0.990375	0.990334	0.990292	0.990250
45	0.990208	0.990167	0.990125	0.990083	0.990040	0.989998	0.989956	0.989914	0.989871	0.989829
46	0.989786	0.989744	0.989701	0.989658	0.989616	0.989573	0.989530	0.989487	0.989444	0.989401
47	0.989358	0.989314	0.989271	0.989228	0.989184	0.989141	0.989097	0.989053	0.989010	0.988966
48	0.988922	0.988878	0.988834	0.988790	0.988746	0.988702	0.988657	0.988613	0.988569	0.988524
49	0.988480	0.988435	0.988390	0.988346	0.988301	0.988256	0.988211	0.988166	0.988121	0.988076
50	0.988030	0.987985	0.987940	0.987894	0.987849	0.987804	0.987758	0.987712	0.987667	0.987621
51	0.987575	0.987529	0.987483	0.987437	0.987391	0.987345	0.987298	0.987252	0.987206	0.987159
52	0.987113	0.987066	0.987020	0.986973	0.986926	0.986879	0.986833	0.986786	0.986739	0.986692
53	0.986644	0.986597	0.986550	0.986503	0.986455	0.986408	0.986360	0.986313	0.986265	0.986217
54	0.986170	0.986122	0.986074	0.986026	0.985978	0.985930	0.985882	0.985833	0.985785	0.985737
55	0.985688	0.985640	0.985591	0.985543	0.985494	0.985446	0.985397	0.985348	0.985299	0.985250
56	0.985201	0.985152	0.985103	0.985054	0.985004	0.984955	0.984906	0.984856	0.984807	0.984757
57	0.984708	0.984658	0.984608	0.984558	0.984509	0.984459	0.984409	0.984359	0.984308	0.984258
°C	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
58	0.984208	0.984158	0.984107	0.984057	0.984007	0.983956	0.983905	0.983855	0.983804	0.983753

59	0.983702	0.983652	0.983601	0.983550	0.983499	0.983448	0.983396	0.983345	0.983294	0.983242
60	0.983191	0.983140	0.983088	0.983036	0.982985	0.982933	0.982881	0.982829	0.982778	0.982726
61	0.982674	0.982621	0.982569	0.982517	0.982465	0.982413	0.982360	0.982308	0.982255	0.982203
62	0.982150	0.982098	0.982045	0.981992	0.981939	0.981886	0.981834	0.981780	0.981727	0.981674
63	0.981621	0.981568	0.981515	0.981461	0.981408	0.981354	0.981301	0.981247	0.981194	0.981140
64	0.981086	0.981032	0.980979	0.980925	0.980871	0.980817	0.980763	0.980708	0.980654	0.980600
65	0.980546	0.980491	0.980437	0.980382	0.980328	0.980273	0.980219	0.980164	0.980109	0.980054
66	0.980000	0.979945	0.979890	0.979835	0.979780	0.979724	0.979669	0.979614	0.979559	0.979503
67	0.979448	0.979392	0.979337	0.979281	0.979226	0.979170	0.979114	0.979058	0.979002	0.978946
68	0.978890	0.978834	0.978778	0.978722	0.978666	0.978610	0.978553	0.978497	0.978441	0.978384
69	0.978328	0.978271	0.978214	0.978158	0.978101	0.978044	0.977987	0.977930	0.977874	0.977816
70	0.977759	0.977702	0.977645	0.977588	0.977531	0.977473	0.977416	0.977358	0.977301	0.977243
71	0.977186	0.977128	0.977070	0.977012	0.976955	0.976897	0.976839	0.976781	0.976723	0.976665
72	0.976607	0.976548	0.976490	0.976432	0.976374	0.976315	0.976257	0.976198	0.976140	0.976081
73	0.976022	0.975963	0.975905	0.975846	0.975787	0.975728	0.975669	0.975610	0.975551	0.975492
74	0.975432	0.975373	0.975314	0.975255	0.975195	0.975136	0.975076	0.975017	0.974957	0.974897



75	0.974838	0.974778	0.974718	0.974658	0.974598	0.974538	0.974478	0.974418	0.974358	0.974298
76	0.974237	0.974177	0.974117	0.974056	0.973996	0.973935	0.973875	0.973814	0.973753	0.973693
77	0.973632	0.973571	0.973510	0.973449	0.973388	0.973327	0.973266	0.973205	0.973144	0.973083
78	0.973021	0.972960	0.972899	0.972837	0.972776	0.972714	0.972653	0.972591	0.972529	0.972468
79	0.972406	0.972344	0.972282	0.972220	0.972158	0.972096	0.972034	0.971972	0.971910	0.971847
80	0.971785	0.971723	0.971660	0.971598	0.971535	0.971473	0.971410	0.971348	0.971285	0.971222
81	0.971159	0.971096	0.971034	0.970971	0.970908	0.970844	0.970781	0.970718	0.970655	0.970592
82	0.970528	0.970465	0.970402	0.970338	0.970275	0.970211	0.970148	0.970084	0.970020	0.969956
83	0.969893	0.969829	0.969765	0.969701	0.969637	0.969573	0.969509	0.969445	0.969380	0.969316
84	0.969252	0.969188	0.969123	0.969059	0.968994	0.968930	0.968865	0.968800	0.968736	0.968671
85	0.968606	0.968541	0.968477	0.968412	0.968347	0.968282	0.968216	0.968151	0.968086	0.968021
86	0.967956	0.967890	0.967825	0.967760	0.967694	0.967629	0.967563	0.967497	0.967432	0.967366
87	0.967300	0.967234	0.967169	0.967103	0.967037	0.966971	0.966905	0.966838	0.966772	0.966706
°C	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
88	0.966640	0.966574	0.966507	0.966441	0.966374	0.966308	0.966241	0.966175	0.966108	0.966042
89	0.965975	0.965908	0.965841	0.965774	0.965707	0.965640	0.965573	0.965506	0.965439	0.965372

90	0.965305	0.965238	0.965170	0.965103	0.965036	0.964968	0.964901	0.964833	0.964765	0.964698
91	0.964630	0.964562	0.964495	0.964427	0.964359	0.964291	0.964223	0.964155	0.964087	0.964019
92	0.963951	0.963882	0.963814	0.963746	0.963677	0.963609	0.963541	0.963472	0.963404	0.963335
93	0.963266	0.963198	0.963129	0.963060	0.962991	0.962922	0.962854	0.962785	0.962716	0.962646
94	0.962577	0.962508	0.962439	0.962370	0.962300	0.962231	0.962162	0.962092	0.962023	0.961953
95	0.961884	0.961814	0.961744	0.961675	0.961605	0.961535	0.961465	0.961395	0.961325	0.961255
96	0.961185	0.961115	0.961045	0.960975	0.960905	0.960834	0.960764	0.960694	0.960623	0.960553
97	0.960482	0.960412	0.960341	0.960271	0.960200	0.960129	0.960058	0.959988	0.959917	0.959846
98	0.959775	0.959704	0.959633	0.959562	0.959490	0.959419	0.959348	0.959277	0.959205	0.959134
99	0.959062	0.958991	0.958920	0.958848	0.958776	0.958705	0.958633	0.958561	0.958489	0.958418
100	0.958346	0.958273	0.958201	0.958129	0.958057	0.957985	0.957913	0.957840	0.957768	0.957696

## Appendix C – Air Density Table

°C	Density in g/cm <sup>3</sup> at the pressure in mbar (=hPa)							
	900	920	940	960	980	1000	1013.25	1050
-10	0.001192	0.001219	0.001245	0.001272	0.001298	0.001325	0.001342	0.001391
-5	0.001170	0.001196	0.001222	0.001248	0.001274	0.001300	0.001317	0.001365
0	0.001148	0.001174	0.001200	0.001225	0.001251	0.001276	0.001293	0.001340
5	0.001128	0.001153	0.001178	0.001203	0.001228	0.001253	0.001270	0.001316
10	0.001108	0.001132	0.001157	0.001182	0.001206	0.001231	0.001247	0.001293
15	0.001088	0.001113	0.001137	0.001161	0.001185	0.001210	0.001226	0.001270
20	0.001070	0.001094	0.001117	0.001141	0.001165	0.001189	0.001205	0.001248
25	0.001052	0.001075	0.001099	0.001122	0.001145	0.001169	0.001184	0.001227
30	0.001035	0.001058	0.001081	0.001104	0.001127	0.001150	0.001165	0.001207
35	0.001018	0.001040	0.001063	0.001086	0.001108	0.001131	0.001146	0.001187
40	0.001001	0.001024	0.001046	0.001068	0.001090	0.001113	0.001127	0.001168
45	0.000986	0.001008	0.001029	0.001051	0.001073	0.001095	0.001110	0.001150
50	0.000970	0.000992	0.001014	0.001035	0.001057	0.001078	0.001093	0.001132
55	0.000956	0.000977	0.000998	0.001019	0.001041	0.001062	0.001076	0.001115
60	0.000941	0.000962	0.000983	0.001004	0.001025	0.001046	0.001060	0.001098
65	0.000927	0.000948	0.000968	0.000989	0.001010	0.001030	0.001044	0.001082
70	0.000914	0.000934	0.000954	0.000975	0.000995	0.001015	0.001029	0.001066
75	0.000901	0.000921	0.000941	0.000961	0.000981	0.001001	0.001014	0.001051
80	0.000888	0.000908	0.000927	0.000947	0.000967	0.000986	0.000999	0.001036
85	0.000875	0.000895	0.000914	0.000934	0.000953	0.000973	0.000986	0.001021
90	0.000863	0.000882	0.000902	0.000921	0.000940	0.000959	0.000972	0.001007

Air density is affected by the air pressure, temperature and humidity. The density of the air is reduced by decreased air pressure, increased temperatures and increased moisture. Putting this relationship on a table could only be done using 3-D graphing, or using a separate graph for each of the three parameters. One can also calculate air density at various temperatures using the formula

$$\text{Density} = \frac{0.0012930}{1 + 0.00367 \times t} \times \frac{\text{Pressure in mbar}}{1013.25}$$

Where t is temperature in °C. Relative Humidity is not accounted for in this formula as it assumes DRY air.

## Appendix D – Printers Supported by Windows

According to the Windows Embedded Standard 7 documentation, the following printer drivers have been included in the Windows build:

### Epson Printers:

EPSON_PX-V630_(M)
Epson_Stylus_C67_Series_(M)
Epson_Stylus_C68_Series_(M)
Epson_Stylus_C87_Series_(M)
Epson_Stylus_C88_Series_(M)
Epson_Stylus_D68_Series_(M)
Epson_Stylus_D88_Series_(M)

### Hewlett Packard Printers:

HP_910
HP_915
HP_Business_Inkjet_1000
HP_Business_Inkjet_1200
HP_Business_Inkjet_2200/2250_(HPA)
HP_Business_Inkjet_2230/2280_HPA
HP_CM8000_Color_MFP_Series_PCL6
HP_Color_Inkjet_cp1700
HP_Color_LaserJet_2700_Series_PCL6
HP_Color_LaserJet_2800_Series_PS
HP_Color_LaserJet_9500_PCL_6
HP_Color_LaserJet_CM3530_MFP_PCL6
HP_Color_LaserJet_CM6030_MFP_PCL6
HP_Color_LaserJet_CM6040_MFP_PCL6
HP_Color_LaserJet_CP1510_Series_PCL6
HP_Color_LaserJet_CP2020_Series_PCL6
HP_Color_LaserJet_CP3505_PCL6
HP_Color_LaserJet_CP3525_PCL6
HP_Color_LaserJet_CP4005_PCL6
HP_Color_LaserJet_CP5220_Series_PCL6
HP_Color_LaserJet_CP6015_PCL6

HP_DeskJet_450
HP_DeskJet_460_Series
HP_DeskJet_5100
HP_DeskJet_5550
HP_DeskJet_5600
HP_DeskJet_6940
HP_DeskJet_6940_Series
HP_DeskJet_6980
HP_DeskJet_6980_Series
HP_DeskJet_9800_Printer
HP_DeskJet_D1300_Series
HP_DeskJet_D1400_Series
HP_DeskJet_D1500_Series
HP_DeskJet_D2300_Series
HP_DeskJet_D2400_Series
HP_DeskJet_D2500_Series
HP_DeskJet_D2600_Series
HP_DeskJet_D4100_Series
HP_DeskJet_D4200_Series
HP_DeskJet_D4300_Series
HP_DeskJet_D730
HP_DeskJet_F2100_Series
HP_DeskJet_F2200_Series
HP_DeskJet_F300_Series
HP_DeskJet_F4100_Series
HP_DeskJet_F4200_Series
HP_DeskJet_F4400_Series
HP_DeskJet_F735
HP_Digital_Copier_410
HP_LaserJet_2200_Series_PCL_5
HP_LaserJet_2300_Series_PS
HP_LaserJet_2300L_PS
HP_LaserJet_3050_PCL5
HP_LaserJet_3052_PCL5
HP_LaserJet_3055_PCL5
HP_LaserJet_3390/3392_PCL5
HP_LaserJet_4100_Series_PCL6
HP_LaserJet_4200/4300_PCL6



HP_LaserJet_4250_PCL6
HP_LaserJet_5200_Series_PCL_5
HP_LaserJet_5200L_Series_PCL_5
HP_LaserJet_9050_mfp_PCL6
HP_LaserJet_CP6015_PCL6
HP_LaserJet_M3027_mfp_PCL6
HP_LaserJet_M3035_mfp_PCL6
HP_LaserJet_M4345_mfp_PCL6
HP_LaserJet_M5025_mfp_PCL6
HP_LaserJet_M5035_mfp_PCL6
HP_LaserJet_M9040_MFP_PCL6
HP_LaserJet_M9050_MFP_PCL6
HP_LaserJet_P2015_PCL6
HP_LaserJet_P2050_Series_PCL6
HP_LaserJet_P3004_PCL6
HP_LaserJet_P3005_PCL6
HP_LaserJet_P3011/P3015_PCL6
HP_LaserJet_P4014/P4015_PCL6
HP_LaserJet_P4515_PCL6
HP_OfficeJet_4300_Series
HP_OfficeJet_5600_Series
HP_OfficeJet_6000_E609a_Series
HP_OfficeJet_6000_E609n_Series
HP_OfficeJet_6100_Series
HP_OfficeJet_6200_Series
HP_OfficeJet_6300_Series
HP_OfficeJet_6500_E709a_Series
HP_OfficeJet_6500_E709n_Series
HP_OfficeJet_7100_Series
HP_OfficeJet_7200_Series
HP_OfficeJet_7300_Series
HP_OfficeJet_7400_Series
HP_OfficeJet_D_Series
HP_OfficeJet_H470_Series
HP_OfficeJet_J3500_Series
HP_OfficeJet_J3600_Series
HP_OfficeJet_J4500_Series
HP_OfficeJet_J4660_Series

HP_OfficeJet_J4680_Series
HP_OfficeJet_J5500_Series
HP_OfficeJet_J5700_Series
HP_OfficeJet_J6400_Series
HP_OfficeJet_K7100_Series
HP_OfficeJet_Pro_8000_A809_Series
HP_OfficeJet_Pro_8500_A909a_Series
HP_OfficeJet_Pro_8500_A909g_Series
HP_OfficeJet_Pro_8500_A909n_Series
HP_OfficeJet_Pro_K5300_Series
HP_OfficeJet_Pro_K5400_Series
HP_OfficeJet_Pro_K550_Series
HP_OfficeJet_Pro_K850_Series
HP_OfficeJet_Pro_K8600_Series
HP_OfficeJet_Pro_L7300_Series
HP_OfficeJet_Pro_L7400_Series
HP_OfficeJet_Pro_L7500_Series
HP_OfficeJet_Pro_L7600_Series
HP_OfficeJet_Pro_L7700_Series
HP_Photosmart_2600_Series
HP_Photosmart_2700_Series
HP_Photosmart_3100_Series
HP_Photosmart_3200_Series
HP_Photosmart_3300_Series
HP_Photosmart_8100_Series
HP_Photosmart_8200_Series
HP_Photosmart_8400_Series
HP_Photosmart_8700_Series
HP_Photosmart_A310_Series
HP_Photosmart_A320_Series
HP_Photosmart_A430_Series
HP_Photosmart_A440_Series
HP_Photosmart_A510_Series
HP_Photosmart_A520_Series
HP_Photosmart_A610_Series
HP_Photosmart_A620_Series
HP_Photosmart_A710_Series
HP_Photosmart_A820_Series

HP_Photosmart_B8500_Series
HP_Photosmart_C309a_Series
HP_Photosmart_C3100_Series
HP_Photosmart_C4100_Series
HP_Photosmart_C4200_Series
HP_Photosmart_C4340_Series
HP_Photosmart_C4380_Series
HP_Photosmart_C4400_Series
HP_Photosmart_C4500_Series
HP_Photosmart_C4600_Series
HP_Photosmart_C5100_Series
HP_Photosmart_C5200_Series
HP_Photosmart_C5300_Series
HP_Photosmart_C5500_Series
HP_Photosmart_C6100_Series
HP_Photosmart_C6200_Series
HP_Photosmart_C6300_Series
HP_Photosmart_C7100_Series
HP_Photosmart_C7200_Series
HP_Photosmart_C8100_Series
HP_Photosmart_D5060_Series
HP_Photosmart_D5100_Series
HP_Photosmart_D5300_Series
HP_Photosmart_D5400_Series
HP_Photosmart_D6100_Series
HP_Photosmart_D7100_Series
HP_Photosmart_D7200_Series
HP_Photosmart_D7300_Series
HP_Photosmart_D7400_Series
HP_Photosmart_D7500_Series
HP_Photosmart_Pro_B8300_Series
HP_PSC_1500_Series
HP_PSC_1600_Series

Lexmark:

Lexmark_E120n_(MS)
Lexmark_E232_(MS)
Lexmark_E234_(MS)

Lexmark_E234n_(MS)
Lexmark_E238_(MS)
Lexmark_E240_(MS)
Lexmark_E240n_(MS)
Lexmark_E250d_(MS)
Lexmark_E250dn_(MS)
Lexmark_E260_(MS)
Lexmark_E260d_(MS)
Lexmark_E260dn_(MS)
Lexmark_E323_(MS)
Lexmark_E330_(MS)
Lexmark_E332n_(MS)
Lexmark_E340_(MS)
Lexmark_E342n_(MS)
Lexmark_E350d_(MS)
Lexmark_E352dn_(MS)
Lexmark_E360d_(MS)
Lexmark_E360dn_(MS)
Lexmark_E450dn_(MS)
Lexmark_E460dn_(MS)
Lexmark_E460dw_(MS)
Lexmark_T650_(MS)
Lexmark_T652_(MS)
Lexmark_T654_(MS)

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