

# ASPHALT PAVEMENT ANALYZER “JUNIOR”



Serial No. 14-228

## USER'S GUIDE

For use with all PC Controlled APA JR's



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# Chapter 1

## 1.1 Overview of Pavement Technology Inc. (PTI)

- A. **Company Mission:** To be the industry leader in manufacturing and developing innovative asphalt and aggregate sampling and testing equipment.
- B. **History:** In the spring of 1996, PTI was formed by a joint venture between Ronald Collins and ASTEC Industries. The first Asphalt Pavement Analyzer and Asphalt Vibratory Compactor were manufactured at ASTEC Industries in Chattanooga, TN. In the fall of 1996 PTI moved to a temporary facility in Conyers, GA. And in the fall of 1998, PTI moved to its current location in Covington, GA.
- C. **Products:** PTI currently manufactures eight products for the asphalt and aggregate industry, they are:
  - 1. The Asphalt Pavement Analyzer (APA)
  - 2. The Asphalt Pavement Analyzer Junior (APA Jr.)
  - 3. The Asphalt Pavement Rut Tester (APRT)
  - 4. The Asphalt Vibratory Compactor (AVC)
  - 5. The Single and Double Pugmill Mixers
  - 6. The Laboratory Automatic Gradation Unit (AGU)
  - 7. The Remote Truck Sampling Device (RTSD)
  - 8. Mobile and Skid Mounted Laboratories
  - 9. Automatic Belt Samplers (ABS)
  - 10. Laboratory Foaming System
- D. **Research/Training:** PTI is dedicated to Asphalt Research and Training for the Hot Mix Asphalt Industry and is available as requested.
- E. **Service:** PTI offers complete service for all company products. We encourage our customers to contact us day or night if they have any problems. Technical help can be given via telephone and if necessary we have a team of fully trained field technicians who can repair any malfunctions.
- F. **People**
  - 1. Ronald Collins, President-PTI. Former Georgia DOT, State Materials and Research Engineer, Retired. He helped in the development of the Georgia Loaded Wheel Tester (GLWT) in 1985 to evaluate rutting characteristics of asphalt while at Georgia DOT. Upon his retirement, Ronald joined with Don Brock, CEO, ASTEC Ind., to develop the modern GLWT known as the APA.
  - 2. Wade Collins, Vice-President-PTI. Wade began working with PTI in 1996. In 1997 Wade took over sales and marketing of all PTI products.
  - 3. Sarah Collins, Office Manager. Sarah joined PTI in February 2004.

## 1.2 Warranty Conditions

1. Products manufactured by Pavement Technology, Inc. (PTI) are warranted to be free of defects in materials and workmanship for a period of 90-days domestic and international, from the date of receipt. If, within such warranty period, any machinery or part should be proved to PTI's satisfaction to be defective, it will be repaired or replaced. Domestic repair or replacement of the defective part may take place at the factory or customer's location as necessary. International repair or replacement of defective parts involving the transportation and lodging of company personnel to a customer's location is not covered by this warranty. Other manufacturers' warranties will apply to such components as motors, pumps, cylinders, gauges, etc. which PTI must purchase outside of its facility.

Note: PTI will not assume responsibility for the cost of repairs or the replacement of parts that result from misuse or abuse of its products in the field by the end user.

2. Should the purchaser cancel a purchase order during or after shipping, it will be the purchasers' responsibility to cover the cost of return shipping.
3. The delivery date on the invoice or proforma is only an estimated date of delivery. PTI will make every effort to insure delivery by the due date. However, should unexpected delays be encountered at the factory, PTI shall not be held financially liable for such delays.
4. PTI's liability insurance does not cover loss or damage to its manufactured products after physical control has been relinquished to the shipping agency. It is recommended, therefore, that the purchaser insure all products ordered from PTI (f.o.b.) to their final destination. If any loss or damage should occur to purchased goods during shipments enroute, PTI is to be held harmless against any claims arising from such loss or damage.

## 1.3 Machine Specifications

### Specifications

Width:	31"
Length:	44"
Height:	68"
Weight:	1,400 Lbs.
Water Tank Capacity:	2.67 Cu Ft, 18 Gallons Full
Power Requirements:	208 or 240 VAC, 50/60HZ, 60Amp, single phase
Air Requirements:	3 SCFM @ 80 PSI, minimum

**Important Note: Although the air consumption is low, the minimum pressure of 70 PSI and maximum 80 PSI should be maintained.**

The machine should be located on a level floor, using the leveling pads to level the machine. The machine is normally operated from the front. A space of 3' in front of the machine should be adequate for the normal operation. A space of 3' is also needed on each side to allow access to the service doors.

**For installation instructions, see section 2.3**

1.4

## **SAFETY INSTRUCTION**

**THE MAIN 240V BREAKER(LOCATED ON THE REAR OF THE  
APA JR) REMOVES ALL  
POWER EXCEPT THAT FROM THE PLUG  
TO MAIN 240V BREAKER.**

**UNPLUG MACHINE BEFORE SERVICING CONTROL PANEL  
COMPONENTS.**

**USE CAUTION WHEN SERVICING ALL ELECTRICAL  
COMPONENTS**

## Chapter 2

# Unpacking and Installing the APA Junior

### 2.1 Checking the Parts

The following parts are included with the APA JR

1. A load cell with quick connect plug to digital scale readout
2. Two spare hoses
3. Two rut sample mold assemblies for 150 mm diameter X 75 mm height round samples
4. Two Hamburg Type Molds 150mm diameter X 62mm height (custom molds available)
5. Two Hamburg Type Solid Stainless Steel Wheels
6. Two Concave Solid Stainless Steel Wheels
7. Two copies of the User's Guide
8. Computer tower, monitor, keyboard, mouse and printer

### 2.2 Major Sub-Assembly Components

This section points out the major parts of the APA JR and gives a brief description of each component. The part names will be used throughout this manual. The machine, as shown in Figure 1, consists of the following basic components:

- (A) Wheel Tracking / Loading system
- (B) Sample Holding Assembly
- (C) Temperature control system
- (D) Water submersion system
- (E) Digital Electronic Regulators
- (F) Operating controls

**(A) Wheel Tracking / Loading System:** The wheel tracking and loading system applies wheel loading with controlled magnitude and contact pressure on beam or cylindrical samples for rut testing, moisture testing, or Hamburg Type Testing. This system consists of the following components.



Figure 2.2.1

- (A1) **Drive Assembly:** Consists of a gearbox motor and a cam and is coupled to the loading assembly. An onboard frequency drive allows a user to run test at multiple speeds and multiple rates of loading



Figure 2.2.2

- (A2) **Loading Assembly:** Consists of a carriage with two linear rails and four pillow blocks. Each wheel has a pneumatic wheel cylinder and a transducer mounted to the cylinder. Each cylinder is attached to a solid stainless steel wheel or concave wheel.



Figure 2.2.3

**(A3) Valve Pack:** The Valve Pack distributes air to maintain load throughout the duration of the test.



Figure 2.2.4

- (A4) **Hose Rack:** The hose rack is used during Rut Testing. It securely holds two Gates 77B 3/4" rubber hoses and is pressurized during testing.



**(B) Sample Holding Assembly:** This assembly holds the asphalt concrete samples directly underneath the rubber hoses to allow the samples to be subjected to the wheel tracking actions during rutting, moisture testing, or Hamburg Type testing.

- (B1) Sample Tray:** Has a Flip-Gate that allows a user to slide the molds with samples underneath the wheels.

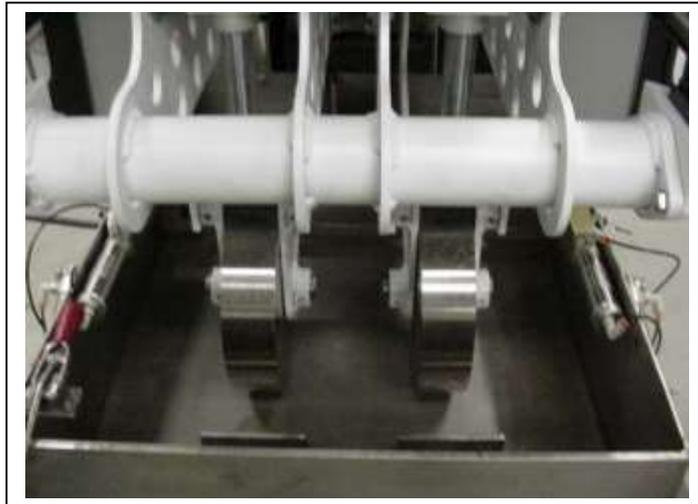


Figure 2.2.6

- (B2) Sample Molds:** Three different mold types are available.
- 1) Cylindrical 150mm Diameter x 75mm Depth Rut Test Mold
  - 2) Cylindrical Hamburg Type Molds
  - 3) All sample molds have the same length and width and are constrained on the sample tray using an automatic clamping system



Figure 2.2.7

- (C) Temperature Control:** Heating the main chamber is provided by a heater box which contains 6 heater strips and a forced air blower fan, which are regulated by a temperature controller.



Figure 2.2.8

(D) **Water System:** The water system allows the samples to be submerged for underwater testing. The system consists of the following components.

(D1) **Water Tray.** Holds the water and samples.. It is used in conjunction with the water tank and pump to maintain water level and temperature throughout the duration of the test.

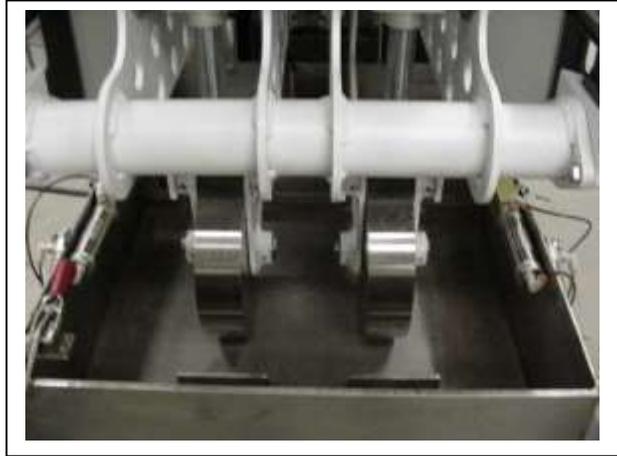


Figure 2.2.9

(D2) **Water tank** contains a heating element, thermocouple, sight tube and an electric pump to pump the water into the water tray. **Very Important, fill tank to within 1/4" of top of tank. Use sight glass located on back of tank to accomplish this.**



Figure 2.2.10

- (D3) **Water tank.** Holds water during and after testing. Fill the tank by pouring water directly into top of water tray or inserting hose into top of weir located at the back of the water tray. **Very important, only fill water to within  $\frac{1}{4}$ " of top of water tank. Use sight glass located on the back of the tank to accomplish this.**



Figure 2.2.11

**Air Regulators:**

1. Air Inlet Regulator: Controls air pressure to APA Jr.. **It is recommended that a desiccant dryer be used between the air compressor and the APA Jr. main regulator. This can be mounted on a wall near the rear of the APA Jr. This device reduces the amount of moisture that enters the APA Jr. through the airline and extends the life of the regulators, valve pack, cylinders, etc.**



Figure 2.2.12

2. Digital Electronic Regulators are used to set and maintain a precise load through the duration of the test.

(G) **Operating Controls:** The APA JR is controlled by a PLC (Programmable Logic Computer). The APA JR Control Bar is the user interface for operating the machine.

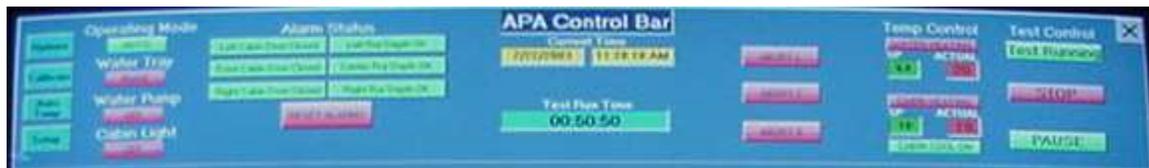


Figure 2.2.14

## 2.3 Installation

After the machine is moved to the designated location, lower and adjust the leveling feet to stabilize and level the machine. Then perform the following installations.

1. Connect the laboratory compressed air supply to the machine via connector located at the back panel of the machine.
2. Check that the power cord is connected to the machine and then to the power source.
3. Unpack and set up the computer. The APA Jr. Profibus cable should be attached to the computer in such a way to avoid placing a side load on the plug.
4. When Power and air is supplied to the APA JR, the sample molds will automatically be locked into place when the Sample Chamber doors are shut.
5. Prior to running test submerged in water, fill water in the water tank to within ¼" of the top of the tank.

## 2.4 Testing the Machine

Follow the steps described below to test the machine after completing the installation procedures described in Section 2.3.

1. Make sure that the EMERGENCY STOP button is pulled out on the front panel of the APA JR.
2. Switch on the computer.
3. Click on the "PTITC" icon located on the desk top.
4. The APA JR Control Bar should load up on the top of the computer screen.
5. Complete necessary calibrations in Chapter 3 Calibrating the Asphalt Pavement Analyzer-Junior. Then proceed to Chapter 4 Asphalt Pavement Analyzer-Junior Test Method to begin using the APA JR.

## Chapter 3

# Calibrating the Asphalt Pavement Analyzer-Junior

*Check the following for calibration before each test.*

*(1) APA JR wheel load, (2) APA JR Vertical, (3) APA JR temperature, and (4) APA JR hose pressure. Instructions for each of these calibration procedures are included in this section.*

### 3.1 APA JR Vertical Calibration

1. Remove the hose rack and any sample molds from the APA JR.
2. Move carriage to the approximate center of travel position by grasping front tube and moving.
3. Close doors. If calibrating for Rut Test, pre-heat the chamber to the testing temperature before proceeding. If calibrating for Hamburg Test, continue to #4.
4. To access the Vertical Calibration, click "Calibrate" on the APA JR Control Bar.
5. The Load Calibration window will open first. Raise each of the two regulator buttons by placing the mouse on the slide and moving 1/4 to 1/3 of the way up. This controls the two electronic regulators that will pressurize the wheel cylinders during the Vertical and Load Calibrations.
6. Click "Yes" to "Do the wheels have adequate pressure for calibration?"
7. In the APA JR Load Calibration window, click "Vertical".
8. **REMOVE ANY SAMPLES FROM CHAMBER BEFORE PROCEEDING.**
9. Automatic Vertical Calibration
  - i. Click "Vertical Cal Off" (Red Button). It will change to "Vertical Cal On" (Green Button).
  - ii. The Computer will automatically calculate the vertical calibration by extending and then retracting both wheels at one time. When it is finished the "Vertical Cal On" will shut itself off and revert to "Vertical Cal Off". A calibration reading of 103.050 +/- .050 should appear under each wheel. If not repeat the calibration.

### 3.2 Wheel Load Calibration: Calibration of wheel pressure using the load cell.

The load cell is used to indicate load being applied by wheel cylinders. The contact pressure for rut testing is 100 lbs and the contact pressure for hamburg testing is 158 lbs.

The following steps are used to calibrate wheel cylinder load.

1. After completing the Vertical Calibration click "Load" to access the Load Calibration window with the regulator buttons.
2. Plug the load cell into the connection located at the upper right of the front door opening.
3. Place the Load Cell under the Left Wheel.
4. Click "Set Left Load"
5. Click "Zero Scale"

6. Click "Down" the wheel will lower onto the load cell and the load will appear above the left wheel calibration.
7. If an adjustment must be made, move the slider button up or down using the mouse until the load is near 100 lbs (APA Test) or 158 lbs (Hamburg Type Test) then raise and lower the wheel (Click "Up" and "Down" and allow the meter to stabilize. Note: Fine adjustments can be made by placing the mouse cursor above or below the button and Left Clicking the mouse. This will in small increments raise or lower the load towards the desired set point.
8. The load should be calibrated to +/- 1 pounds of the desired set point.
9. Click "Up"
10. Place the Load Cell under the Right Wheel.
11. Click "Set Right Load"
12. Repeat steps 4, 5, 6, 7 and 8.
13. Remove Load Cell

**This Vertical and Load Calibrations should be performed before each test.**

### **3.3 APA JR Hose Pressure Check**

*(From APA JR Calibration; ASTM Format)*

A.5.1 The air pressure in the APA JR test hoses shall be checked with a NIST traceable test gauge or transducer with a suitable range. The check shall be made while the APA JR is operating. Since the hoses are connected in series, it is satisfactory to connect the test gauge to the end of the right-most hose. The pressure should not fluctuate outside of the range of  $700 \pm 35$  kPa ( $100 \pm 5$  PSI) during normal operation. Adjust the pressure as necessary with the hose pressure regulator.

Note: The Ashcroft test gauge model 450182As02L200# has been found to be satisfactory for this purpose. This gauge may available through Grainger (Stock No. 2F00)

### **3.4 APA JR Temperature Calibration**

*(From APA JR Calibration; ASTM Format)*

A.2.1 The APA JR must be calibrated with a NIST traceable thermometer (an ASTM 65 C calibrated thermometer is recommended) and a metal thermometer well to avoid rapid heat loss when checking the temperature.

#### A.2.2 Temperature Stability

A.2.2.1 Turn on the APA JR main power and set the chamber temperature controller so that the temperature inside the testing chamber is about 60 C. Also, set the water temperature controller to achieve approximately 60 C water temperature. Place the thermometer in the well and place them on the left side of the shelf where the samples and molds will be tested. (Note-it may be helpful to remove the hose rack from the APA JR during temperature calibration to avoid breaking the thermometer.)

A.2.2.2 It usually takes about two hours for the APA to stabilize. After the temperature display on the controller has stabilized, open the chamber doors and read the thermometer without removing it from the well. Record this temperature. Close the chamber doors.

A.2.2.3 Thirty minutes after obtaining the first reading, obtain another reading of the thermometer. Record this temperature. If the readings from step A.2.2.2 and A.2.2.3 are within 0.4 C, then average the readings. If the readings differ by more than 0.4 C then continue to take readings every thirty minutes until the temperature stabilizes within 0.4 C on two consecutive readings.

#### A.2.3 Temperature Uniformity

A.2.3.1 To check the uniformity of the temperature in the APA chamber, move the thermometer and well to the right side of the shelf where the samples are tested. Take and record readings of the thermometer at the second location every thirty minutes until two consecutive readings at the second location are within 0.4 C.

A.2.3.2 Compare the average of the two readings at the left side with the average of the stabilized temperature at the right side. If the average temperatures from the two locations are within 0.4 C, then the APA temperature is relatively uniform and it is suitable for use. If the average of the readings at the two locations differ by more than 0.4 C then consult with the manufacturer on improving temperature uniformity.

#### A.2.4 Temperature Accuracy

A.2.4.1 Average the temperatures from the two locations. If that average temperature is within 0.4 C of the desired temperature of 60 C, then the APA temperature is reasonably accurate and calibration is complete.

A.2.4.2 If the average temperature differs from the desired temperature of 60 C by more than 0.4 C, then adjust the APA temperature controller so that the thermometer and well will be at the desired temperature of 60 C.

A.2.4.3 Place the thermometer and well in the center of the shelf. At thirty minute intervals, take readings of the thermometer. When two consecutive readings are within 0.4 C, and the average of the two consecutive readings are within 0.4C of the desired test temperature of 60 C, then the APA temperature has been properly adjusted and calibration at that temperature is complete. Record the current set points on the temperature controllers for later reference. If these two conditions are not met, then repeat steps A.2.4.2 and A.2.4.3

### 3.5 Calibrating the Temperature Controller

If the temperature in the APA is not correct, this procedure may be used to correct the temperature differential.

1. On the **APA Control Bar** click "Calibrate".
2. On the **APA Calibration** window click "Temperature"
3. Enter the desired correction factor and press "Enter" on the keyboard

### 3.6 load Cell Calibration

The APA Load Cell is calibrated at the factory and should be calibrated once a year by an independent lab. The difference between the measured weight and the known weight should be less than 1 lbs @ 100lbs of load. If the discrepancy with the measured load value verses an object of known weight is more than 1lbs @ 100lbs of load, call PTI for instructions.

### 3.7 Wheel and Cam Follower Removal and Installation

#### Wheel Removal

1. Remove the hose rack and test samples
2. Click "Calibrate"
3. Click the Left or Right Wheel "Down" icon
4. With a ¼" Allen wrench, loosen axle cap screw and slide axle out of wheel
  - a. Rut wheels will have spacers on either side of the wheel

#### Wheel installation

1. Slide the axle through the axle carrier until the spacer(s) will hang on it.
  - i. For APA Test, install two thick washers.
  - ii. For Hamburg Type Test, just install wheel.
  - iii. Note: If the axle does not slide through with gentle tapping.
2. Hold the wheel in place and slide the axle through it
3. Slide the next spacer(s) up into position
4. The wheel should turn freely.
5. Tighten all screws.

#### Cam Follower Removal/Installation

1. Open a side door.
2. Use the "Jog" button on the "Calibration" window to bring the carriage all the way forward.  
Note: The "Hertz" slide bar on the Control Bar must be set above 0 (zero) for the "Jog" to function.
3. Loosen the nut from the cam follower on the top side of the Cam Plate. A 5/16 Allen wrench should be used on the bottom of the cam follower to stop the cam follower from turning.
4. There are two holes in the cam plate, one for the APA Test and the second for the Hamburg Type Test. With the Cam Plate facing forwards, the hole nearest the front of the APA jr is for the APA Test. The hole towards the rear is for the Hamburg Type Test.
5. Move the cam follower to the correct test position and tighten the nut.

## Chapter 4 Asphalt Pavement Analyzer Test Method

### 4.1 (ASTM Format) Standard Test Method For Determining Rutting Susceptibility Using The Automated Asphalt Pavement Analyzer

1. SCOPE 1.1 This method describes a procedure for testing the rutting susceptibility of asphalt-aggregate mixtures using dynamic loading applications in the Automated Asphalt Pavement Analyzer (Automated APA) to simulate traffic. 1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only. 1.3 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulations prior to use.

#### 2. REFERENCED DOCUMENTS

- 2.1 ASTM Standards
  - D 979 Standard Practice for Sampling Bituminous Paving Mixtures
  - D 2726 Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens*
  - D 2041 Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
  - D 3203 Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Mixtures
  - E 178 Standard Practice for Dealing With Outlying Observations

3. APPARATUS: 3.1 Asphalt Pavement Analyzer (APA) – A thermostatically controlled device designed to test the rutting susceptibility of hot mix asphalt by applying repetitive linear loads to compacted test specimens through pressurized linear hoses.

3.1.1 The APA shall be thermostatically controlled to maintain the test temperature at any set point between 5° and 72° C within 1° C.

3.1.2 The APA shall be capable of independently applying loads up to 450N to the two wheels. The loads shall be calibrated to the desired test load by an external force transducer.

3.1.3 The pressure in the test hoses shall be adjustable and capable of maintaining pressure up to 830 kPa. (120PSI)

3.1.4 The APA shall be capable of testing two beam specimens simultaneously.

3.1.5 The APA shall have a programmable master cycle counter which can be preset to the desired number of cycles for a test. The APA shall be capable of automatically stopping the test at the completion of the programmed number of cycles.

3.1.6 The hoses shall be Gates 77B Paint Spray and Chemical 19mm ID (3/4 inch, 5.17 Mpa (750 PSI) W.P. GL 07148. The hoses should be replaced when any of the outer rubber casings has worn through and threads are exposed. Follow the APA manufacturer's instructions for the technique on replacing hoses.

3.2 Balance, 12,000-gram capacity, accurate to 0.1 gram.

3.3 Mixing utensils (bowls, spoon, spatula)

3.4 Ovens for heating aggregate and asphalt cement.

3.5 Compaction device and molds.

4. PREPARATION OF TEST SPECIMENS: 4.1 Number of Test Specimens – One test will use either three beam (75mm x 125mm x 300mm (3"x5"x12") specimens or six cylindrical (150mm diameter x 75mm)(6" diameter x 3") specimens.

Note: Mold extensions are available for cylindrical specimens greater than 75mm tall.

4.2 Roadway Core Specimens                      4.2.1 Roadway core specimens shall be 150 mm diameter with all surfaces of the perimeter perpendicular to the surface and of the core within 5 mm. Cores shall be trimmed with a wet masonry saw to a height of  $75 \pm 3$  mm.

#### 4.3 Plant Produced Mixtures

4.3.1 Samples of plant produced mixtures shall be obtained in accordance with ASTM 979 (AASHTO T 169). Mixture samples shall be reduced to the appropriate test size and compacted while the mixture is still hot. Reheating of loose plant mixture should be avoided.

#### 4.4 Laboratory Prepared Mixtures

4.4.1 Mixture proportions are batched in accordance with the desired Job Mix Formula. Required batch sizes are determined in accordance with the Appendix XI.

4.4.2 The temperature to which the asphalt binder must be heated to achieve a viscosity of  $170 \pm 20$  cSt shall be the mixing temperature. For modified asphalt binders, use the mixing temperature recommended by the binder manufacturer.

4.4.3 Dry mix aggregates and hydrated lime first (when lime is used), then add optimum percentage of asphalt cement. Mix the materials until all aggregates are thoroughly coated.

4.4.4 Test samples shall be aged in accordance with the short-term aging procedure in AASHTO PP2

4.4.5 The temperature to which the asphalt binder must be heated to achieve a viscosity of  $280 \pm 30$  cSt shall be the compaction temperature. For modified asphalt binders, use the compaction temperature recommended by the binder manufacturer.

#### 4.5 Laboratory Compaction of Specimens

4.5.1 One of several devices may be used to compact specimens in the laboratory. Details regarding the procedures for compacting specimens in each device should be referenced to the equipment manufacturer's instructions.

Note: Recent studies have shown that samples compacted with different laboratory compaction devices may have significantly different results. Each state agency should select one method as the standard for their agency.

4.5.2 Laboratory prepared specimens shall be compacted to contain  $7.0 \pm 1.0\%$  air voids or as otherwise specified by the agency.

4.5.3 Compacted specimens should be left at room temperature (approximately  $25^\circ$  C) to allow the entire specimen to cool for a minimum of 3 hours.

### 5. DETERMINING THE AIR VOID CONTENTS

5.1 Determine the bulk specific gravity of the test specimens in accordance with ASTM: D 2726 (AASHTO: T 166).

5.2 Determine the maximum specific gravity of the test mixture in accordance with ASTM: D 2041 (AASHTO: T 209).

5.3 Determine the air void contents of the test specimens in accordance with ASTM: D 3203 (AASHTO: T 269).

### 6. CALIBRATING THE ASPHALT PAVEMENT ANALYZER

6.1 The Wheel Load should be calibrated when the APA Control Bar (on the computer) is closed and reopened, when the hoses in the hose rack are changed or when changes are made in the APA air supply system

6.1.1 For instructions see section 3.1 of this manual

6.2 The Vertical Measuring System should be calibrated when the APA Control Bar (on the computer) is closed and reopened or when the rut or fatigue wheels are exchanged.

6.2.1 For instructions see sections 3.2 of this manual

### 7. SELECTING THE TEST TEMPERATURE

7.1 The test temperature shall be set to the high temperature of the standard Superpave Binder Performance Grade for the specifying agency. For circumstances where the binder grade has been bumped, the APA test temperature will remain at the standard PG high temperature.

## 8. SPECIMEN PREHEATING

8.1 Place the specimens in the molds.

8.2 Specimens shall be preheated in the temperature calibrated APA test chamber or a separate calibrated oven for a minimum of 6 hours. Specimens should not be held at elevated temperatures for more than 24 hours prior to testing.

## 9. PROCEDURE

9.1 Set the hose pressure gage reading to  $700 \pm 35$  kPa ( $100 \pm 5$  PSI). Set the load cylinder pressure reading for each wheel to achieve a load of  $445 \pm 22$  N ( $100 \pm 5$  lb.).

9.2 Stabilize the testing chamber temperature at the temperature selected in Paragraph 7.

9. Secure the preheated, molded specimens in the APA. The preheated APA chamber should not be opened more than 6 minutes when securing the test specimens into the machine. Close the chamber doors and allow 10 minutes for the temperature to restabilize prior to starting the test.

9.3 Initialize the computer with the APA and begin the test.

9.3.1 For instructions in the operation of the computer see section 4.2 Rutting Test: AVMS Operating Instructions

## 10. REPORT

10.1 The test report shall include the following information:

10.1.1 The laboratory name, technician name and date of test.

10.1.2 The mixture type and description.

10.1.3 Specimen type.

10.1.4 Average air void content of the test specimens.

10.1.5 The test temperature.

10.1.6 The average rut depth to the nearest 0.1 mm at 8000 cycles.

10.1.7 Print out of the Data Sheet

10.1.8 Print Out of the Rut Chart

## ANNEX (Mandatory Information)

### A. CALIBRATION

The following items should be checked for calibration no less than once per year: (1) preheating oven, (2) APA temperature, (See section 3.5 APA Temperature Calibration) (3) APA wheel load, (See section 3.1 Wheel Load Calibration) (4) APA Vertical Calibration, (See section 3.2 APA Vertical Calibration) and (5) APA hose pressure (See section 3.3 APA Hose Pressure Check).

A.1. Temperature calibration of the preheating oven.

A.1.1 The preheating oven must be calibrated with a NIST traceable thermometer (an ASTM 65 C calibrated thermometer is recommended) and a metal thermometer well to avoid rapid heat loss when checking the temperature.

### A.1.2 Temperature Stability

A.1.2.1 Set the oven to the chosen temperature (e.g. 60 C). Place the thermometer in the well and place them on the center of the shelf where the samples and molds will be preheated.

It usually takes an hour or so for the oven chamber, well and thermometer to stabilize. After one hour, open the oven door and read the thermometer without removing it from the well. Record this temperature. Close the oven door.

A.1.2.2 Thirty minutes after obtaining the first reading, obtain another reading of the thermometer. Record this temperature. If the readings from step 2.1 and 2.2 are within 0.4 C, then average the readings. If the readings differ by more than 0.4 C then continue to take readings every thirty minutes until the temperature stabilizes within 0.4 C on two consecutive readings.

### A.1.3 Temperature Uniformity

A.1.3.1 To check the uniformity of the temperature in the oven chamber, move the thermometer and well to another location in the oven so that they are on a shelf where samples and molds will be preheated, but as far as possible from the first location. Take and record readings of the thermometer at the second location every thirty minutes until two consecutive readings at the second location are within 0.4 C.

A.1.3.2 Compare the average of the two readings at the first location with the average of the stabilized temperature at the second location. If the average temperatures from the two locations are within 0.4 C, then the oven temperature is relatively uniform and it is suitable for use preheating APA samples. If the average of the readings at the two locations differ by more than 0.4 C then you must find another oven that will hold this level of uniformity and meets calibration.

### A.1.4 Temperature Accuracy

A.1.4.1 Average the temperatures from the two locations. If that average temperature is within 0.4 C of the set point temperature on the oven, then the oven is reasonably accurate and calibration is complete.

A.1.4.2 If the set point differs from the average temperature by more than 0.4 C, then adjust the oven set point appropriately to raise or lower the temperature inside the chamber so that the thermometer and well will be at the desired temperature (e.g. 60 C).

A.1.4.3 Place the thermometer and well in the center of the shelf. At thirty-minute intervals, take readings of the thermometer. When two consecutive readings are within 0.4 C, and the average of the two consecutive readings are within 0.4C of the desired test temperature (e.g. 60 C), then the oven has been properly adjusted and calibration is complete. If these two conditions are not met, then repeat steps A.1.4.2 and A.1.4.3.

## APPENDIX XI

### X. Calculation of Specimen Masses

#### X.1 Beam Specimens

X.1.1 Volume of specimen = 75 mm x 125 mm x 300 mm = 2812.5 cm<sup>3</sup>.

X.1.2 Total mass of beam specimen, g = Gmm @ Opt. A.C. x 0.93 x 2812.5 cm<sup>3</sup>

X.1.3 Beams may be batched in 1, 2 or 3 layers. Divide the total mass by the number of layers.

X.1.4 Individual weights for dry aggregate, lime and liquid A. C. per layer.

X.1.4.1 Mass of asphalt cement, g = grams/layer x % A. C. @ Opt.

X.1.4.2 Mass of aggregate, g = grams/layer – grams of A. C. (This includes lime, if used in the mixture).

X.1.4.3 Mass of aggregate excluding lime, g = grams of aggregate/1.01

X.1.4.4 Mass of lime, g = grams of aggregate – grams of aggregate excluding lime.

## X.2 Cylindrical Specimens

X.2.1 Volume of Specimen =  $(0.7854 \times (150 \text{ mm})^2 \times 75 \text{ mm})/1000 = 1325.4 \text{ cm}^3$

X.2.2 Total mass of cylindrical specimen, g = Gmm @ Opt. A. C. x 0.93 x 1325.4 cm<sup>3</sup>

X.2.3 Individual weights for dry aggregate, lime and liquid A. C. per layer

X.2.3.1 Mass of asphalt cement, g = grams/layer x % A. C. @ Opt.

X.2.3.2 Mass of aggregate, g = grams/layer – grams of A. C. (this includes lime, if used in the mixture).

X.2.3.3 Mass of aggregate excluding lime, g = grams of aggregate/1.01

X.2.3.4 Mass of lime, g = grams of aggregate - grams of aggregate excluding lime.

## 4.2 Rutting Test: Operating Instructions

1. Place the specimens in the sample chamber of the APA.
2. Perform all necessary calibrations from Chapter 3 Calibrating the Asphalt Pavement Analyzer.
3. Click the “Cabin Heating” button (Red) under **Temp Control** to activate the heat system (turns Green).
  - i. To change the temperature click on the green box, under the “Cabin Heating” button, labeled **SP** (Set Point) and enter the desired temperature value. Click “ENTER”.
  - ii. To delay the start of heating, do not click “Cabin Heating”. Instead click “Auto Temp”, click “Cabin Heat”, enter the date and the desired time to begin heating.
4. Click “Test Setup”.
5. Choose **Rut Test** and click “OK”.
6. The next window will be Rut Test Parameters. From this window the user may:
  - i. Change the length of the test. The Test Length default setting is 8000 cycles.
  - ii. Change specimen type to cylindrical molds if necessary by clicking “Click For Cylindrical Molds”. Beam specimens are the default setting.
  - iii. Turn off any wheel that will not be used.
  - iv. Change the Max Rut depth Value.
  - v. Set the hose pressure to 100 +/-5 with booster regulator.
7. After entering any changes, click “Next”.
8. When asked “Are you sure?”, click “Yes”.
9. The button under **Common Controls** should be in “Manual” mode (Red). Click “Manual” to enter into “Auto” mode (Green).
10. To start the test, click the **Test Control** “Start” button two times. It will now be “Test Running”
11. If the test will not start, check **Alarm Status** and close the indicated door. Then click “Reset Alarms”.
12. The test may be paused and restarted at any time. Click “Pause” and the Carriage Assembly will stop but the wheels will stay down.
  - a. Opening the front doors will also pause the test. To restart, close the doors and click “Reset Alarms”.
13. To end a test before the end of the cycle countdown, click “Stop”. The Carriage Assembly will stop and the wheels will retract. It will not be possible to restart the same test.
14. To end the test on one wheel without stopping the test, click “Abort L” (Left wheel retracts), or “Abort R” (Right wheel retracts). The test will continue to run unless all three wheels are selected.
15. If manual measurements are taken, they can be recorded on the Data Sheet. Record manual measurements in the “white” cells labeled 1, 2, 3, 4, or 5.
16. On the Data Sheet, enter the Project #, Mix ID #, etc.
17. To change the plot setting on the Rut Chart, place the mouse cursor over the white background of the chart and double click. A pop up window will appear with the default setting of 100. The user may choose any value from 1-8000.
18. **DO NOT** save test in the folder that automatically open (APA2), this is part of the program. Create a folder in MY Documents . To save the test click “File” and “Save As”. Enter a file name and click “Save”. If the program is closed before saving, the computer will prompt to save.
 

**Note: If at any time the computer loses power before saving, all test data will be lost. It is recommended that each customer purchase a UPS (Uninterruptible Power Source) with at least a 30 minute run time.**
19. To open a saved test, first open Excel, then click “File” and click “Open”. Find the folder where the file is stored and open the saved test.
20. To print any view, click “File”, “Print Preview” and “Print.”

### 4.3 (ASTM Format) Standard Test Method For Determining Moisture Damage Susceptibility Using The Automated Asphalt Pavement Analyzer

1. SCOPE 1.1 This method describes a procedure for testing the moisture damage susceptibility of asphalt-aggregate mixtures using dynamic loading applications in the Automated Asphalt Pavement Analyzer (APA) to simulate traffic. 1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only. 1.3 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulations prior to use.

2. REFERENCED DOCUMENTS 2.1 ASTM Standards: D: 979 Standard Practice for Sampling Bituminous Paving Mixtures D: 2726 Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens D: 2041 Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures D: 3203 Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Mixtures

E: 178 Standard Practice for Dealing With Outlying Observations

2.2 AASHTO: PP-2 Short and Long Term Aging of Hot Mix Asphalt.

3. APPARATUS: 3.1 Asphalt Pavement Analyzer (APA) – A thermostatically controlled device designed to test the moisture damage (submerged deformation) susceptibility of hot mix asphalt by applying repetitive linear loads to compacted test specimens through pressurized linear hoses.

3.1.1 The APA shall be thermostatically controlled to maintain the test water temperature at any set point between 40° and 65° C within 1° C (104° to 149° F ± 2° F). 3.1.2 The APA shall be capable of independently applying loads up to 450N (208 pounds) to the three wheels. The loads shall be calibrated to the desired test load by an external force transducer.

3.1.3 The pressure in the test hoses shall be adjustable and capable of maintaining pressure up to 830 kPa. (120PSI)

3.1.4 The APA shall be capable of testing three submerged beam specimens simultaneously.

3.1.5 The APA shall have a programmable master cycle counter which can be preset to the desired number of cycles for a test. The APA shall be capable of automatically stopping the test at the completion of the programmed number of cycles.

3.1.6 The hoses shall be Gates 77B Paint Spray and Chemical 19mm ID (3/4 inch, 5.17 Mpa (750 PSI) W.P. GL 07148. The hoses should be replaced when any of the outer rubber casings has worn through and threads are exposed. Follow the APA manufacturer's instructions for the technique on replacing hoses.

3.6 Balance, 12,000-gram capacity, accurate to 0.1 gram.

3.7 Mixing utensils (bowls, spoon, spatula)

3.8 Ovens for heating aggregate and asphalt cement.

3.9 Compaction device and molds.

4. PREPARATION OF TEST SPECIMENS: 4.1 Number of Test Specimens – One test will use either three beam (75mm x 125mm x 300mm (3"x5"x12") specimens or six cylindrical (150mm diameter x 75mm)(6" diameter x 3") specimens.

Note: Mold extensions are available for cylindrical specimens greater than 75mm tall.

4.2 Roadway Core Specimens 4.2.1 Roadway core specimens shall be 150 mm diameter with all surfaces of the perimeter perpendicular to the surface and of the core within 5 mm. Cores shall be trimmed with a wet masonry saw to a height of 75± 3 mm.

4.3 Plant Produced Mixtures shall be prepared according to Section 4.1.

4.4 Laboratory Prepared Mixtures

4.4.1 Mixture proportions are batched in accordance with the desired Job Mix Formula.

Required batch sizes are determined in accordance with the Appendix.

4.4.2 The temperature to which the asphalt binder must be heated to achieve a viscosity of  $170 \pm 20$  cSt shall be the mixing temperature. For modified asphalt binders, use the mixing temperature recommended by the binder manufacturer.

4.4.3 Dry mix aggregates and any solid additive first, then add optimum percentage of asphalt cement. Mix the materials until all aggregates are thoroughly coated.

4.4.4 Test samples shall be aged in accordance with the short-term aging procedure in AASHTO PP2

4.4.5 The temperature to which the asphalt binder must be heated to achieve a viscosity of  $280 \pm 30$  cSt shall be the compaction temperature. For modified asphalt binders, use the compaction temperature recommended by the binder manufacturer.

#### 4.5 Laboratory Compaction of Specimens

4.5.1 One of several devices may be used to compact specimens in the laboratory. Details regarding the procedures for compacting specimens in each device should be referenced to the equipment manufacturer's instructions.

4.5.2 Laboratory prepared specimens shall be compacted to contain  $7.0 \pm 1.0\%$  air voids or as otherwise specified by the agency.

4.5.3 Compacted specimens should be left at room temperature (approximately  $25^\circ\text{C}$ ) to allow the entire specimen to cool for a minimum of 3 hours.

5. DETERMINING THE AIR VOID CONTENTS  
test specimens in accordance with  
ASTM: D 2726 (AASHTO: T 166).

5.2 Determine the maximum specific gravity of the test mixture in accordance with ASTM: D 2041 (AASHTO: T 209).

5.3 Determine the air void contents of the test specimens in accordance with ASTM: D 3203 (AASHTO: T 269).

5.1 Determine the bulk specific gravity of the

## 6. PREPARING THE ASPHALT PAVEMENT ANALYZER

6.1 Set the hose gauge pressure to read  $700 \pm 35$  kPa ( $100 \pm 5$  PSI), and set the cylinder pressure for each wheel to a load of  $445 \pm 22$  N ( $100 \pm 5$  pounds), or as specified by the agency.

6.2 Set the preset counter to 8000 cycles.

## 7. SELECTING THE WATER TEST TEMPERATURE

7.1 The water test temperature shall be one performance grade below the high temperature of the standard Superpave Binder Performance Grade for the project conditions. For circumstances where the binder grade has been bumped, the APA test water temperature will remain at one performance grade below the standard PG high temperature.

## 8. PRECONDITIONING TEST SPECIMENS:

Specimens may be preconditioned using the following procedures, or by procedures specified by the agency.

8.1 Place the specimens into a vacuum container supported above the container bottom by a spacer.

8.1.1 Fill the container with distilled water at room temperature so that one-inch of water is above the top of the specimens.

8.1.2 Apply a vacuum of 13 – 67 kPa absolute pressure (26 to 10 inches Hg partial pressure) for five to ten (5 – 10) minutes. Remove the vacuum and leave the specimen submerged in water for five to ten (5 – 10) minutes.

8.1.3 Determine the bulk specific gravity of the specimen by ASTM: D 2726 (AASHTO: T-166). Calculate the volume of absorbed water (J) in cubic centimeters (CC) using the following equation:

$$J = B' - B$$

where,

J = volume of absorbed water in CC

B' = Mass of saturated Surface-Dry specimens after partial vacuum, grams

(section 8.1.4).

B = Mass of saturated Surface-Dry specimen prior to vacuum saturation, grams

(section 5.1).

8.1.4 Determine the degree of saturation by comparison the volume of absorbed water (J) with the volume of air voids (I) from section 5.1 using the following equation:

$$S' = \frac{100J}{I}$$

where,

S' = Degree of saturation, percent

J = Volume of absorbed water, CC

I = Volume of air voids, CC

If the degree of saturation is between 55 and 80 percent, proceed with Section 8.1.6.

8.1.5 If the degree of saturation is less than 55 percent, repeat the procedure beginning with section 8.1 using more vacuum and/or time. If the volume of water is more than 80 percent, the specimen may have been damaged and must be discarded. Repeat the procedure with a new specimen beginning with section 8.1 using less vacuum and/or time. If no Freeze–Thaw is to be applied, proceed to section 8.17.

8.1.6 Cover each of the vacuum saturated specimens tightly with a plastic film such as saran wrap, place the wrapped specimen into a plastic bag containing 10 ml of water and seal the bag. Place the plastic bag containing the specimens into a freezer at a temperature of  $-18^{\circ}\text{C} \pm 3^{\circ}\text{C}$  ( $0 \pm 5^{\circ}\text{F}$ ) for at least 16 hours. Remove the specimens from the freezer.

8.1.7 Place the specimens into a bath containing water at the temperature specified in Section 7 for  $24 \pm 1$  hour. As soon as possible, remove the plastic bag and film from the specimens if samples were freeze thawed.

## 9. TEST PROCEDURE:

9.1 Place the preconditioned specimens from Section 8.1.7 into the Asphalt Pavement Analyzer mold and tighten the mold.

9.2 Place the molds with the preconditioned specimens into the APA and center them beneath the hoses.

9.3 Raise the water tank and fill it with water to submerge the test specimens and allow to sit undisturbed for  $2 \pm \frac{1}{4}$  hours.

9.4 Start the APA and allow it to run for 8000 cycles; exercise caution to prevent developing an excessively deep rut to avoid damage to the wheels by their contact with the test specimen.

9.4.1 For instructions in the operation of the computer see section 4.2 Rutting Test: AVMS Operating Instructions

## 10. REPORT

10.1 The test report shall include the following information.

10.1.1 The laboratory name, technician name and date of test.

10.1.2 The mixture type and description.

10.1.3 Specimen type.

10.1.4 Average air voids and average voids filled with water (%)

10.1.5 The water test temperature.

10.1.6 The average rut depth to the nearest 0.1 mm and the number of APA wheel cycles

applied.

10.1.7 Print out of the Data Sheet

10.1.8 Print Out of the Rut Chart

## APPENDIX XI

## XI. Calculation of Specimen Masses

## X1.1 Beam Specimens

X1.1.1 Volume of specimen = 75 mm x 125 mm x 300 mm = 2812.5 cm<sup>3</sup>.

X1.1.2 Total mass of beam specimen, g = Gmm @ Opt. A.C. x 0.93 x 2812.5 cm<sup>3</sup>

X1.1.3 Beams may be batched in 1, 2 or 3 layers. Divide the total mass by the number of layers.

X1.1.4 Individual weights for dry aggregate, lime and liquid A. C. per layer.

X1.1.4.1 Mass of asphalt cement, g = grams/layer x % A. C. @ Opt.

X1.1.4.2 Mass of aggregate, g = grams/layer – grams of A. C. (This includes lime, if used in the mixture).

X1.1.4.3 Mass of aggregate excluding lime, g = grams of aggregate/1.01

X1.1.4.4 Mass of lime, g = grams of aggregate – grams of aggregate excluding lime.

## X1.2 Cylindrical Specimens

X1.2.1 Volume of Specimen =  $(0.7854 \times (150 \text{ mm})^2 \times 75 \text{ mm})/1000 = 1325.4 \text{ cm}^3$

X1.2.2 Total mass of cylindrical specimen, g = Gmm @ Opt. A. C. x 0.93 x 1325.4 cm<sup>3</sup>

X1.2.3 Individual weights for dry aggregate, lime and liquid A. C. per layer

X1.2.3.1 Mass of asphalt cement, g = grams/layer x % A. C. @ Opt.

X1.2.3.2 Mass of aggregate, g = grams/layer – grams of A. C. (this includes lime, if used in the mixture).

X1.2.3.3 Mass of aggregate excluding lime, g = grams of aggregate/1.01

X1.2.3.4 Mass of lime, g = grams of aggregate - grams of aggregate excluding lime.

## 4.4 APA Jr. Moisture Test: Operating Instructions

- A. Preheating the water before the test
1. Perform all necessary calibrations from Chapter 3 Calibrating the Asphalt Pavement Analyzer.
  2. Click “Water Heating” (Red) turns to “Water Heat On” (Green).
    - i. To change the water temperature click on the green box, under the “Water Heating” button, labeled SP (Set Point) and enter the desired temperature value.
  3. Click the “Cabin Heating” button (Red) under **Temperature Control** to activate the heat system (turns Green).
    - a. To change the temperature click on the green box, under the Cabin Heating button, labeled SP (Set Point) and enter the same temperature as the water temperature.
- B. Starting the test
1. Place the specimens in the sample chamber of the APA.
  2. Under **Common Controls** click “Water Pump” (Red) turns green
  3. Click “Test Setup”
  4. Choose **Moisture Test** and click “OK”.
  5. The next window will be Moisture Test Parameters. From this window the user may:
    - a. Change the length of the test. The Test Length default setting is 8000 cycles.
    - b. Change specimen type to cylindrical molds if necessary. Beam specimens are the default setting.
    - c. Turn off any wheel that will not be used.
    - d. Change the Max Rut depth Value.
    - e. Change the Data Point Settings.
    - f. Set the hose pressure to 100 +/-5PSI. The default pressure is 100 PSI. If a new value is entered, press “Enter” on the keyboard.
  6. After entering any changes, click “Next”.
  7. When asked “Are you sure?”, click “Yes”.
  8. Click “Yes” to the Active X Control
  9. The button under **Common Controls** should be in “Manual” mode (Red). Click “Manual” to enter into “Auto” mode (Green).
  10. To start the test, click the **Test Control** “Start” button (2 Times). It will now be “Test Running”.
  11. If the test will not start, check **Alarm Status** and close the indicated door. Then click “Reset Alarms”.
  12. The test may be paused and restarted at any time. Click “Pause” and the Carriage Assembly will stop but the wheels will stay down.
    - i. Opening the front doors will also pause the test. To restart, close the doors and click “Reset Alarms”.
  13. To end a test before the end of the cycle countdown, click “Stop”. The Carriage Assembly will stop and the wheels will retract. It will not be possible to restart the same test.
  14. To end the test on one wheel without stopping the test, click “Abort L” (Left wheel retracts), (Right wheel retracts). The test will continue to run unless both wheels are selected.
  15. If manual measurements are taken, they can be recorded on the Data Sheet. Record manual measurements in the “white” cells labeled 1, 2, 3, 4, or 5.
  16. On the Data Sheet, enter the Project #, Mix ID #, etc.
  17. **DO NOT** save test in the folder that automatically opens (APA2), this is part of the program. Create a folder in My Documents or on the desktop to save your test in. To save the test click “File” and “Save As”. Enter a file name and click “Save”. If the program is closed before saving, the computer will prompt to save.

**Note: If at any time the computer loses power before saving, all test data will be lost. It is recommended that each customer purchase a UPS (Uninterruptible Power Source) with at least a 30 minute run time.**

18. To open a saved test, first open Excel, then click "File" and click "Open". Find the folder where the file is stored and open the saved test. Do not try to open the test file without first opening Excel. The computer will not be able to find the test file and open it.
19. To print any view, click "File", "Print Preview" and "Print."

## 4.5 APA Jr. Hamburg Type Test: Operating Instructions

1. Open front and rear doors of the unit. Make sure that the drain valve located in the bottom right hand corner of the water tank is in the closed position.
2. Fill water tank by pouring water into the top tray, or by placing a water hose directly into the weir opening located at the back of the tray. **Fill the tank to within 1/4" of top of tank. Use the sight glass located on the back of the water tank to accomplish this.**
  - i. Note: When pouring water into top tray the tank will fill very slowly. DO NOT over fill. Allow time for the water to drain into the tank.
  - ii. **Note: Always check water level before every test. Evaporation will decrease the water level significantly.**
3. Turn computer on. The desktop will appear. Click on the "PTI TC" icon and the Control Bar will appear. Under Test Setup, Hamburg Test may be selected.
4. Enter the testing temperature on the Control Bar by typing the testing temp in the "SP" (Set Point) window. Water Heat should be set to 50 C. Click the "Water Heat" icons to turn the heaters on. Once water and cabin heat reach the set point, allow the water and chamber to stabilize for approx 20-30 minutes.
5. Perform all necessary calibrations from Chapter 3 Calibrating the Asphalt Pavement Analyzer.
6. Set correction factors (if needed) for Water Heat.
  - i. To enter correction factor, click "Calibration" and then "Temperature" and enter correction amount
  - ii. Use a (-) minus sign for negative values.
7. Install the molds and the samples in the tray aligning the samples under the wheels. Slots in the mold can be aligned with the slots on the front bar clamp. Move the carriage to the back of its travel.
8. Click the "Water Pump" icon to clamp the samples and start filling the tray. Filling will take approximately 3-5 minutes.
9. Click the "Test Setup" icon located in the top left corner of the Control Bar. The test selection window will appear. Click on the Hamburg Type Test and click "OK".
  - i. Click ("default") Make sure 20,000 passes is entered in the pass count.
  - ii. Select wheels to be used. Left or Right or Both.
  - iii. Max Rut Default is 12.5
  - iv. Turn on all five read indicators and adjust for Hamburg testing..
  - v. To change number of passes, click on 20,000 and enter the desired pass count. Click "Enter" after or it will default back to 20,000.
10. Maximize data sheet.
11. The button under **Common Controls** should be in "Manual" mode (Red). Click "Manual" to enter into "Auto" mode (Green).
12. To start the test, click the **Test Control** "Start" button. It will now be "Test Running".
13. If the test will not start, check **Alarm Status**. Then click "Reset Alarms".

14. The test may be paused and restarted at any time. Click "Pause" and the Carriage Assembly will stop but the wheels will stay down. Hamburg test may be run with the front door open or closed. Front door may be opened during a test.
  - i. Opening the side doors will stop the test. It is Not possible to restart the test.
15. To end a test before the end of the cycle countdown, click "Stop". The Carriage Assembly will stop and the wheels will retract. It will not be possible to restart the same test.
16. To end the test on one wheel without stopping the test, click "Abort L" (Left wheel retracts), or "Abort R" (Right wheel retracts). The test will continue to run unless both wheels are selected.
17. It is advised to turn the water pump off after test is complete. Water heat may remain on if additional testing is to be performed.
18. If manual measurements are taken, they can be recorded on the Data Sheet. Record manual measurements in the "white" cells labeled 1, 2, 3, 4, or 5.
19. On the Data Sheet, enter the Project #, Mix ID #, etc.
20. To change the plot setting on the Rut Chart, place the mouse cursor over the white background of the chart and double click. A pop up window will appear with the default setting of 100. The user may choose any value from 1-8000.
21. **DO NOT** save test in the folder that automatically open (APA2), this is part of the program. Create a folder in MY Documents or on the desktop to save your test in. To save the test click "File" and "Save As". Enter a file name and click "Save". If the program is closed before saving, the computer will prompt to save.
22. **Note: If at any time the computer loses power before saving, all test data will be lost. It is recommended that each customer purchase a UPS (Uninterruptible Power Source) with at least a 30 minute run time.**
23. To open a saved test, first open Excel, then click "File" and click "Open". Find the folder where the file is stored and open the saved test. Do not try to open the test file without first opening Excel. The computer will not be able to find the test file and open it.
24. To print any view, click "File", "Print Preview" and "Print."

## Chapter 5 Maintenance

### 5.1 Replacement of Rubber Hoses

The special high-pressure hoses have the life expectancy of about 20-30 8000-cycle rutting tests, depending on the abrasiveness of the asphalt mixtures being tested. Use the following type of hose for replacement: Specification: Gates 77B, 3/4 in., 750-PSI hose.

- A. Checking for wear on the hoses
  1. Remove the hose rack from the APA.
  2. Observe the bottom of the hoses for excessive wear.
  3. Grab the hose in the palm of the hand and press the worn places with your fingertips.
  4. A good hose will be resistant to deformation, if the hose is easily depressed replace immediately.
  
- B. Hose replacement
  1. If replacement hoses are not immediately available, measure the inside diameter of the rack from front to back.
  2. Have this measurement ready and call PTI for new hoses.
  
- C. Hose Installation
  1. Remove the old hoses and hose clamps before removing the hose barb adapters from the hose rack. Cutting lengthwise through the rubber hose at the hose barb is the easiest method of removal. See Figure 2.2.5
  2. Remove the 3 hose barbs from the rear of the hose rack. The three hose barbs in the front of the rack should be left in place if possible.
  3. Lubricating the hose barb adapters with a small amount of water or Windex may ease the installation of the adapters into the hoses. (Note: **do not** use dishwashing soap or grease or the hose will twist during rut testing.)
  4. Start the hose onto the front hose barbs. It may be necessary to tap them on with a hammer.
  5. Each hose should slide all the way up to the shoulder of each adapter.
  6. Tighten down the hose clamp.
  7. Insert the hose barb into the other end of the hose.
  8. If insertion is difficult, the hammer may be used but place the nut onto the threads to protect it from the hammer head.
  9. Install the rear hose clamp
  10. Install the rear hose barb into the hose rack and put the nut in place.
  11. Tighten the rear hose barb adapters until the hose is stretched 1 inch (2.5 cm) longer than its original length.

- D. Calibrating the hoses to the wheel path
1. Place two sample molds onto the sample tray and turn them upside down. This will allow the hose rack to rest on a solid surface for proper calibration.
  2. Install the hose rack into the APA and couple the air quick connect.
  3. Shut the sample tray doors and use the stroke jog to position the carriage assembly at the back of the test chamber.
  4. Turn the Left Cylinder switch (or Middle or Right) to calibrate.
  5. Observe the position of the wheel to the hose.
  6. If the wheel and hose are in alignment, raise the cylinder and proceed to calibrate the middle and right hoses beginning at step 4.
  7. If the hose is out of line with the wheel, turn the cylinder switch to off and remove the hose rack.
  8. Loosen the rear-retaining nut and move the hose to the right or left as necessary. Repeat steps 2 through 8.
  9. When the rear of the hose rack is finished, close the sample tray doors and use the stroke jog to bring the carriage assembly to the front of the test chamber.
  10. Repeat steps 4 through 8 until finished.
  11. Turn all of the cylinder switches to auto and start the APA.
  12. Be sure that all of the wheels are centered over each hose.
  13. If all of the wheels are tracking properly, the APA is ready for use.

## 5.2 APA Lubrication

1. The pillow block bearings should be greased on a regular basis with Magnalube grease. Do not over grease. Two good pumps with the grease gun is enough in each bearing. Grease should be applied to the groove in the follower plate.
2. The SMC cylinders, regulators and valve pack are pre-lubricated and do not require oil.
3. The gear oil for the drive assembly should be checked once per year.

## 5.3 Keeping Moisture Out of the Pneumatic Controls

1. It is essential that the APA air system be kept free from moisture in the compressed air.
2. The connecting rod seals of the wheel cylinders are very susceptible to moisture and may be permanently damaged if moisture is allowed into the APA.
3. In order for PTI to warranty the cylinders, regulators and valve pack in the APA, a refrigerated air dryer must be used.
4. If the customer's location already has a refrigerated air dryer, it is the customer's responsibility to keep it in good working order.
5. PTI offers a refrigerated air dryer specifically for the APA and, if used properly, will guarantee the APA against moisture damage.
6. If moisture does enter the APA,
  - a. Discover the reason for the failure of the air dryer.
  - b. Disconnect all effected airlines both inside and outside of the APA.
  - c. Turn the compressed air on and blow the moisture out of the lines.
7. If moisture does enter the APA or if moisture continues to be a problem, it may be necessary to add 30-weight turbine oil to the system oiler, see Fig 2.2.14. Turbine oil will protect the APA against moisture damage but it must be checked and maintained regularly for the life of the machine.

# Chapter 6

## Computer Software Installation Instructions

### 6.1 Computer Software Installation

If an error occurs in the performance of the APA software, it may be reloaded with the following steps.

1. Click "Windows Explorer"
2. On the C drive locate the folder "APA Backup" and click on the folder. A folder labeled "APA VB Prj" should be visible. If the "APA Backup" folder was not available. Place the APA CD in the CD-Rom Drive and find the folder labeled "APA VB Prj".
3. Right click and copy the "APA VB Prj" folder.
4. Place the cursor over the "Local Disc (C:)" icon. Right click and paste. Note: Do not paste the "APA VB Prj" over the folder on the C drive labeled "APA VB Prj".
5. If asked to Overwrite, click "Yes".

## Chapter 7 Trouble Shooting and Electrical Drawings

### 7.1 Trouble Shooting the APA Jr.

1. Wheels lower but do not move.
  - a. Check door-warning lights.
  - b. Check "Resume" button
  - c. Click "Reset Alarms"
  - d. Check circuit breaker.
  - e. Check frequency drive (Open Left Door) for F0070 fault. Switch Main Power off 5 seconds and switch on again will reset the drive.
2. Water level low during submerged test
  - a. Check water level in tank. Make sure water level indicator reads "Tank Full" before starting each test.
  - b. Check circuit breaker marked "P"
  - c. If running only one wheel, place empty second mold in tray for water displacement.
3. Water will not heat to selected temperature.
  - a. Check circuit breaker for water heater.
  - b. Pull up Moisture Test and allow Excel sheets to open. Then start water heat.

- c. Check water heater element.
- d. Check thermocouple.
- e. Check correction factor.

Water will not pump

- a. Check circuit breaker marked "P"
  - b. Check for prime on pump. Blow air through tube on back of tray.
  - c. Check "Y" strainer on back at water pump. Remove filter and clean.
4. Cabinet will not heat to selected temperature.
- a. Check heater circuit breaker.
  - b. Check blower for power.
  - c. Check for air leaks around doors.
  - d. Check thermocouple
  - e. Click on "test set up" Rut test
  - f. Click on "auto-on" select cabin heat and set time to come on.
  - g. Turn Control Bar OFF and then turn back ON.

**5. Wheels lift prematurely**

- a. **Check vertical calibration. Was Vertical Calibration performed before starting test and performed at test temperature.**
- b. **Check sample height. Make sure sample heights are within 2mm's of each other.**
- c. **Check transducers for tightness.**
- d. **Raised wheels should read 103.050. Lowered wheels should read 0.00. The lower number will fluctuate slightly. The top number of 103.050 will fluctuate slightly but should not read past or below 103. If the transducer reads 102 or 104, repeat the calibration process. Check for loose transducer. Check for any damage to cable.**
- e. **Check for loose bearings or yokes.**

**6. Wheels Extend but do not move**

- a. **Check Control Bar. Make sure the "Pause" button is not showing.**
- b. **Reset Frequency Drive**

Should frequency drive need to be re-set.

**Quick commissioning: click on the "P", Use up arrow and go to P0010. Click "P" and use up arrow to enter 1. Click "P" use up arrow and go to P3900. Click "P" and use up arrow to enter 1. Click "P" "BUSY"**