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16. Abstract

This report provides the user manual for TxDOT's new overlay tester and a draft specification for mix acceptance.

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USER MANUAL FOR TXDOT'S NEW OVERLAY TESTER

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DISCLAIMER

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the Texas Department of Transportation (TxDOT) or the Federal Highway Administration (FHWA). This report does not constitute a standard, specification, or regulation. The engineer in charge was Tom Scullion, P.E. (Texas, # 62683).

There was no invention or discovery conceived or first actually reduced to practice in the course of or under this contract, including any art, method, process, machine, manufacture, design or composition of matter, or any new useful improvement thereof, or any variety of plant, which is or may be patentable under the patent laws of the United States of America or any foreign country.

ACKNOWLEDGMENTS

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INTRODUCTION

Figure 1 shows the TxDOT's brand new overlay tester. Operation of the machine is straightforward. In normal operations, it is necessary to use only the positioning switches and a single software interface screen since all operations during a test are automatic. Clean the machine at least daily during use. The test is normally performed in displacement control. The brief user manual is described below.
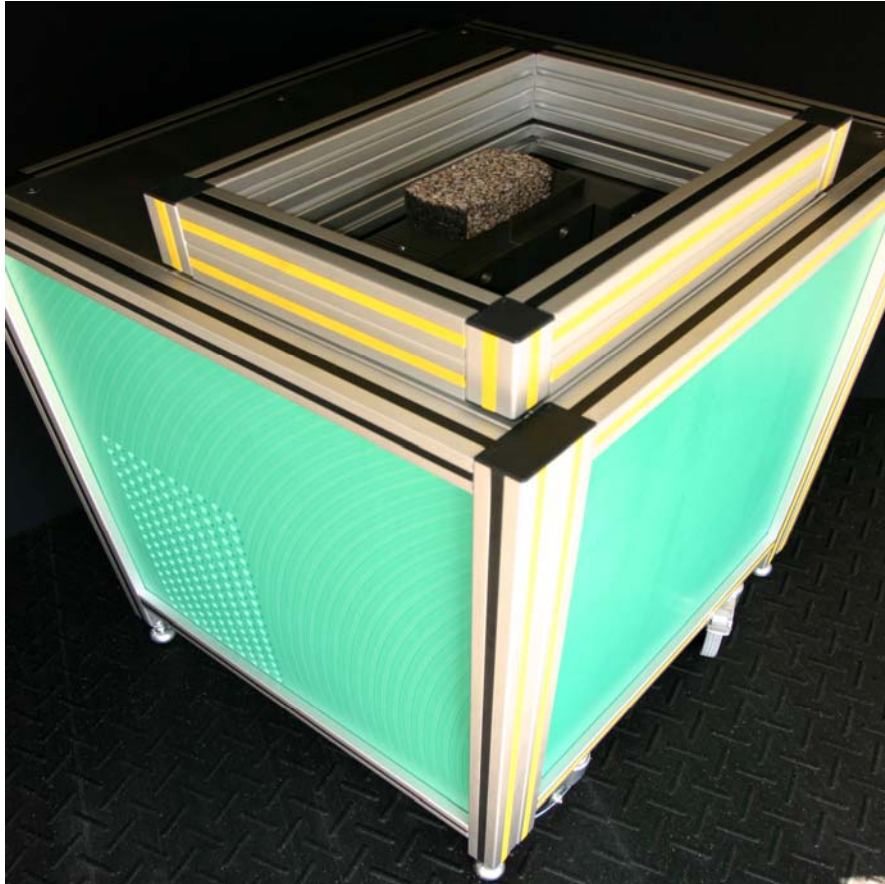

Figure 1. TxDOT's Brand New Overlay Tester.

SPECIMEN PREPARATION AND INSTALLATION

Generally, a specimen is fabricated from a field core or a lab compacted specimen. If a round core is used, it is usually cut from a 6 inch core to be 1 ½ inch high and 3 inch wide by 6 inch long. Other beam lengths and configurations may be used, depending on the mounting plates used. The plates are mounted on a specimen mounting jig (Figure 2), and the specimen is then glued to the plates (Figure 3). Epoxy is usually used as an adhesive. Beams should be preconditioned to the temperature at which they will be tested.
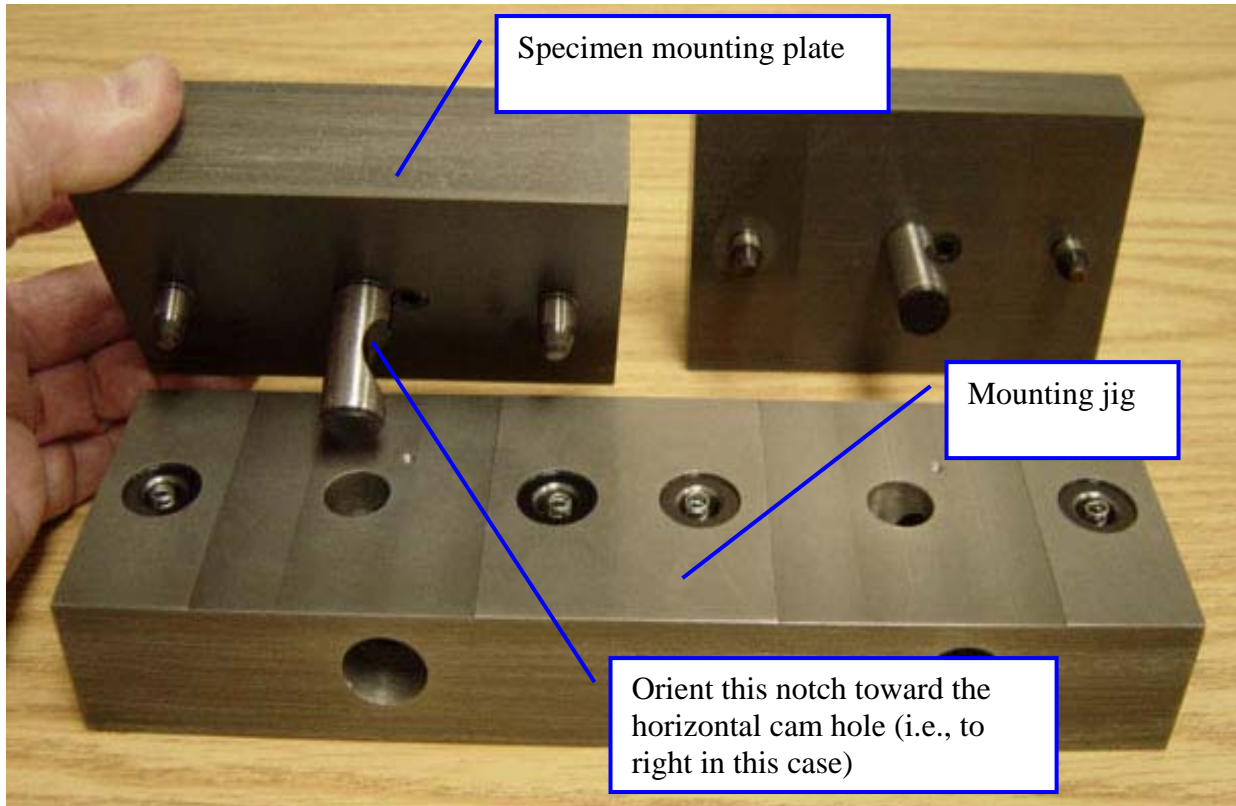
Figure 2. Mounting Jig.
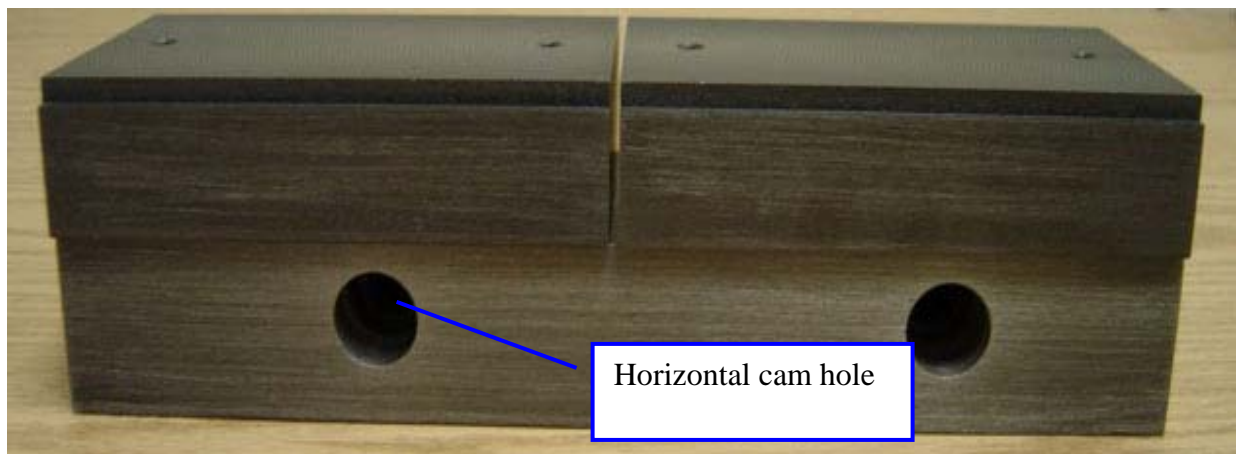
Figure 3. Specimen Plates Mounted on Jig.

START-UP AND TEST SPECIMEN ASSEMBLY INSTALLATION

1. The Emergency Stop switch must be in the released position (partially rotating the switch allows it to pop out to the released position if it has been previously pushed in). Turn the Master switch on (Figure 4). The refrigeration system will start when this switch is turned on. Set the temperature controller to the desired temperature, and wait until it stabilizes.

Figure 4. Main Control Panel.

2. After the main switch has been turned on, turn on the computer and after a period of at least one minute, start the overlay test software. Once the software is loaded, the hydraulic pump can be turned on through the software (Figure 5). In order to mount the specimen assembly onto the machine, it may be necessary to adjust the position of the testing machine blocks. This adjustment can be done with the Load/Stroke and Left/Right switches (Figure 6). Although the Stroke mode can be used for this purpose, it is recommended that the Load mode be used because inadvertent loads applied during mounting of the specimen will be automatically minimized by the control system if it is in load control. Use the Left/Right switch to move the right hand testing block on the machine in the desired direction to line up the pins on the specimen mounting plates. Although the software automatically switches the system to displacement control for the test, it is recommended that operators get in the habit of repositioning the switch back to displacement control before closing the lid of the machine.
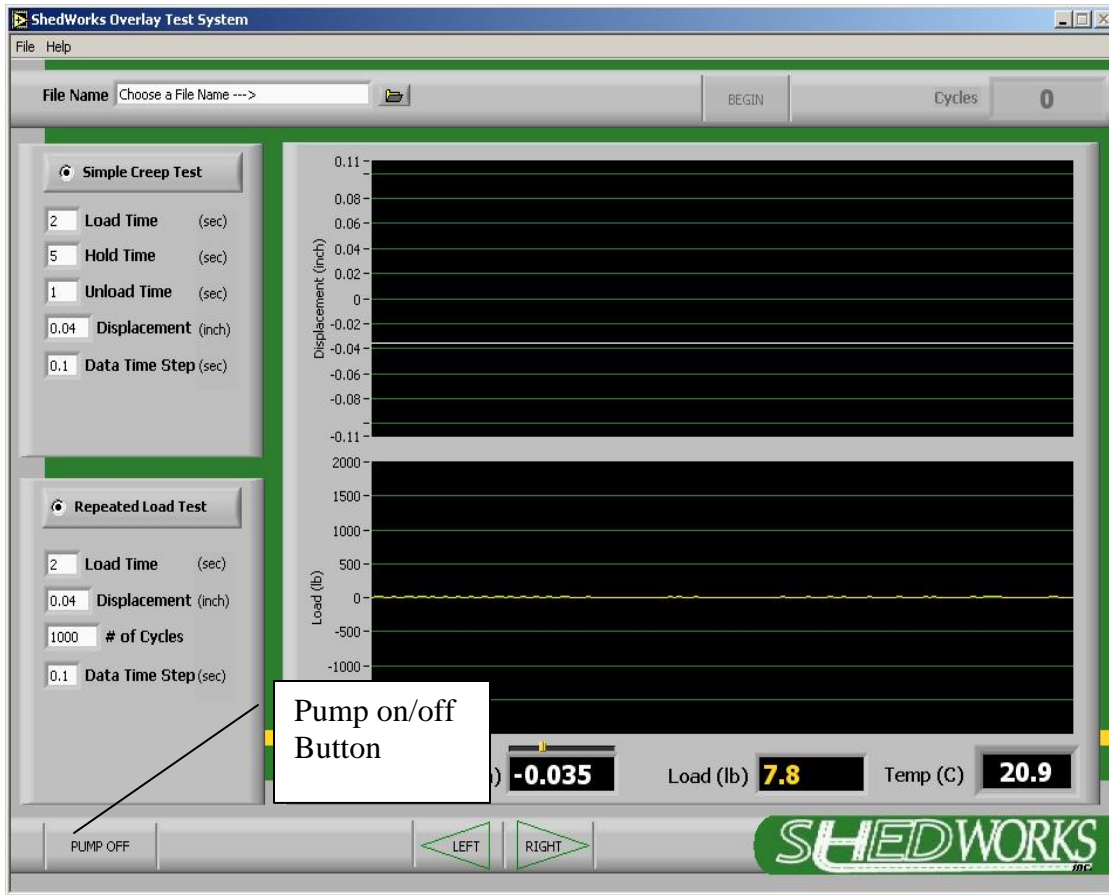
Figure 5. Hydraulic Pump On/Off.

Figure 6. Mode Control Switches.

3. As shown in Figures 7 through 9, once the pins are aligned, the test specimen assembly may be placed in the machine and the locking cams can be tightened. The cams will tighten after approximately ¼ - ½ turn. There is one cam on the fixed part of the testing machine and one on the moving part. A 3/8 inch socket drive handle with a 3 inch extension is provided to lock and unlock the specimen plates.

> NOTE: Make sure that both the bottom of the specimen plates and the top of the testing machine are clean before placing the test specimen assembly into the testing device. If all four surfaces are not clean, damage may occur to the machine or the plates when the plates are tightened with the cams. These four surfaces are hard anodized aluminum that protects against corrosion and minor abrasion, but it will not protect against impact and gouging type damage. Do not use extreme force to push the test specimen assembly down onto the machine (e.g., never use a hammer to force the pins into the holes on the blocks). The assembly should slide into place with minimal force if it is properly aligned.

Figure 7. Position Right Hand Block with Left/Right Switch to Line Up Pins on Test Specimen Assembly.

Figure 8. Insert Pins into Machine Making Sure Cutout on Center Pin Is on the Side Facing the Cams (Cutout Facing to Right).

Figure 9. Tighten Cam until It Locks in Place.

BASIC SOFTWARE OPERATION

4. Select the desired test(s), enter the desired control parameters, specify a file name, and begin the test. Active buttons have dark lettering. The Begin button is not active until a file name is specified. The Pump button toggles the hydraulic pump on and off. The radio buttons on Stress Relax Test and Repeated Load (displacement) Test (Figure 10) are independent so that either one or both of these tests may be specified. When the Begin button is pushed, the selected test or tests will automatically be performed in sequence.

> NOTE: It is not necessary to manually position the actuator so that the displacement reading is zero before the test. The software automatically corrects for an initial displacement reading that is not zero.
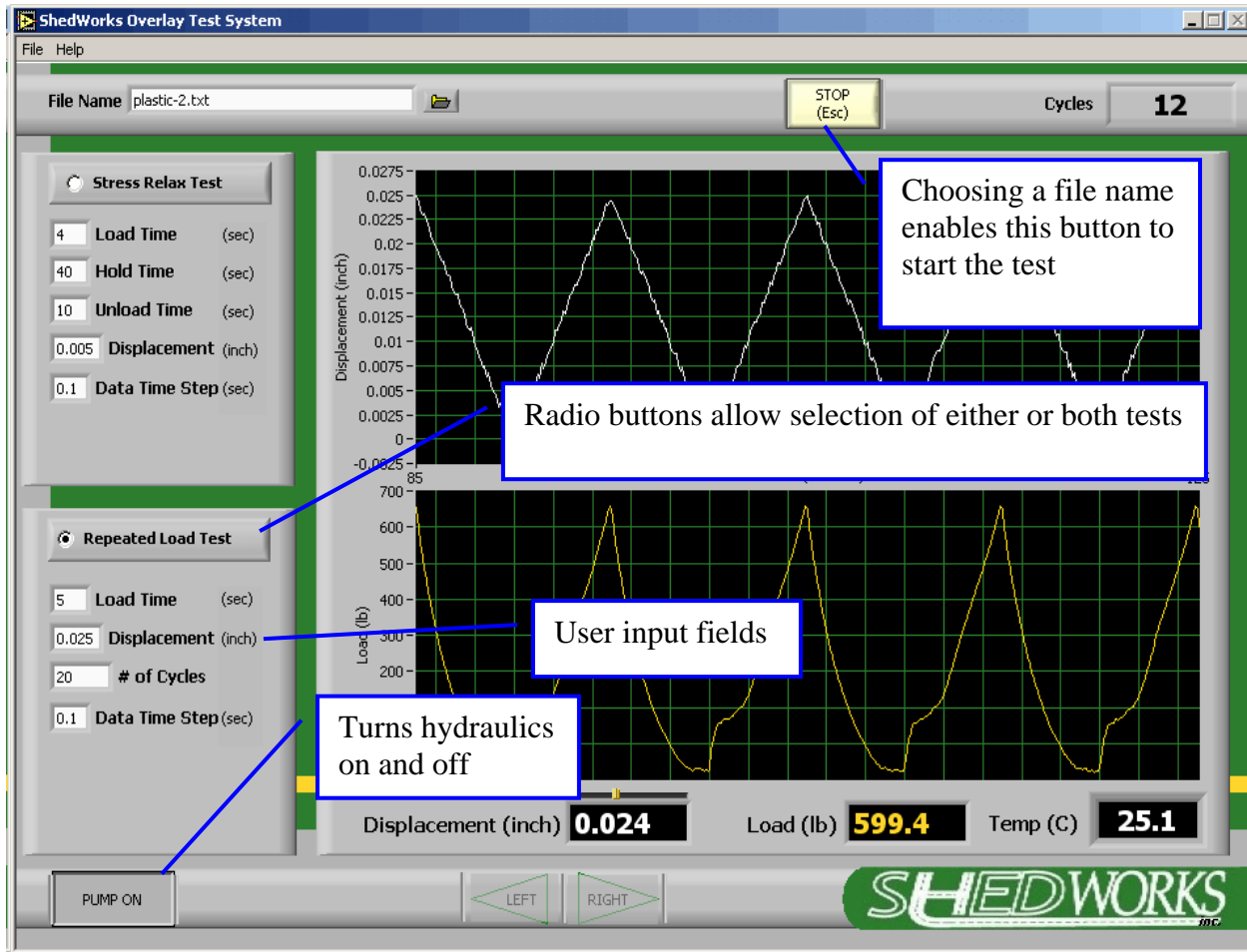
Figure 10. Main Software Screen.

5. During the test, a time history plot of displacement and load is presented. In addition, digital indicators are shown, and a completed number of cycles are presented for the repeated load portion of the test. This is a displacement (i.e., stroke) controlled test. Therefore, the feedback control should show the desired waveform on the displacement plot. The load is a response signal in this case and is merely recording what is happening to the load during the process of applying the displacement. In this example (Figure 11), the specimen is very weak, because it has already been partially failed in previous tests. Although the displacement is being moved only in the tension direction relative to the initial position, the load shows both compression and tension readings. Generally, the compressive load readings are indicators of time dependence and/or damage to the specimen because the <u>position</u> (not the load) is being forced back to zero during each cycle.
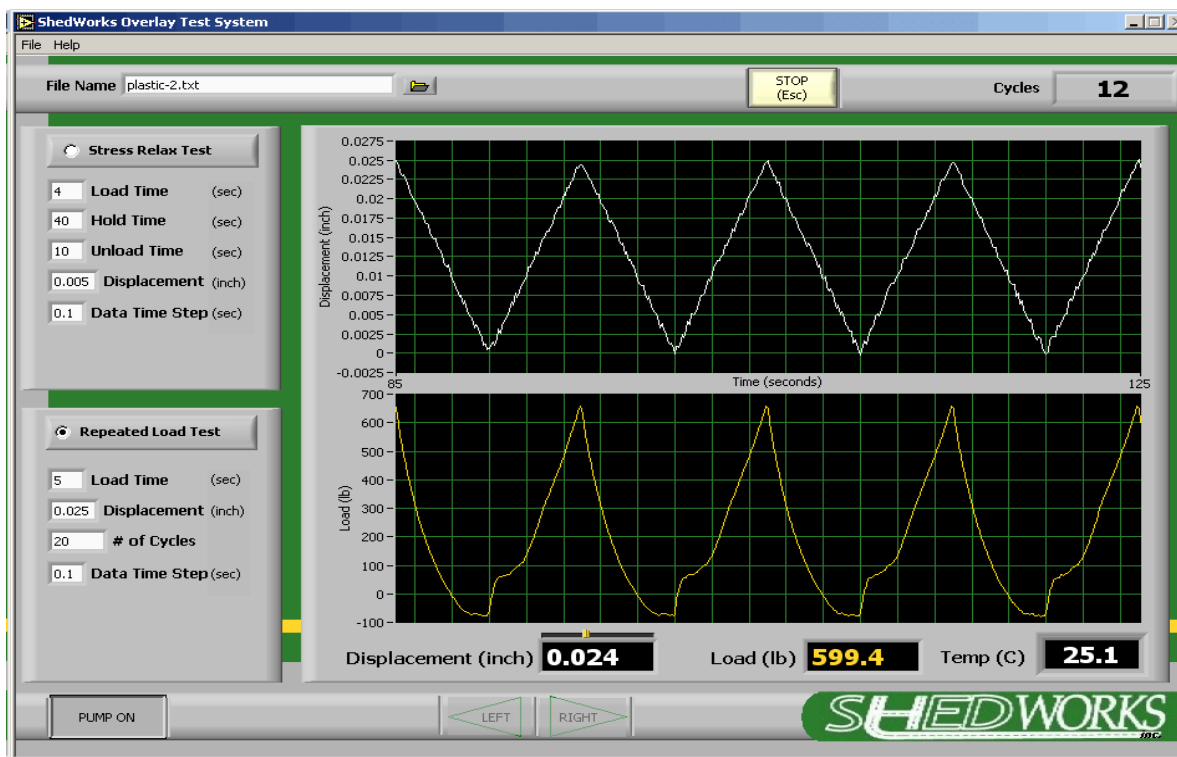

Figure 11. Typical Display during Testing.

6. After the file is saved and closed at the end of the test, open the lid, switch to load control, and reposition with the Left/Right switch if necessary to remove the specimen assembly and insert a new one. If the specimen broke during the test, it will not be necessary to adjust the position of the block with the Left/Right switch since each half of the assembly can be removed independently. However, it will likely be necessary to reposition the block to insert a new specimen assembly.

SOFTWARE DETAILS

The software is very simple to operate. However, there are features available that require some expertise to correctly utilize and there are some features that are not often used in the normal course of testing.

There are two forms of help files available in the software: a context sensitive button help (Figure 12) and a general help file (Figure 13). When in the button help mode, passing the cursor over a particular area of the screen will pop up a short help window discussion of the item. The general help file contains basic information about the test and machine operation.
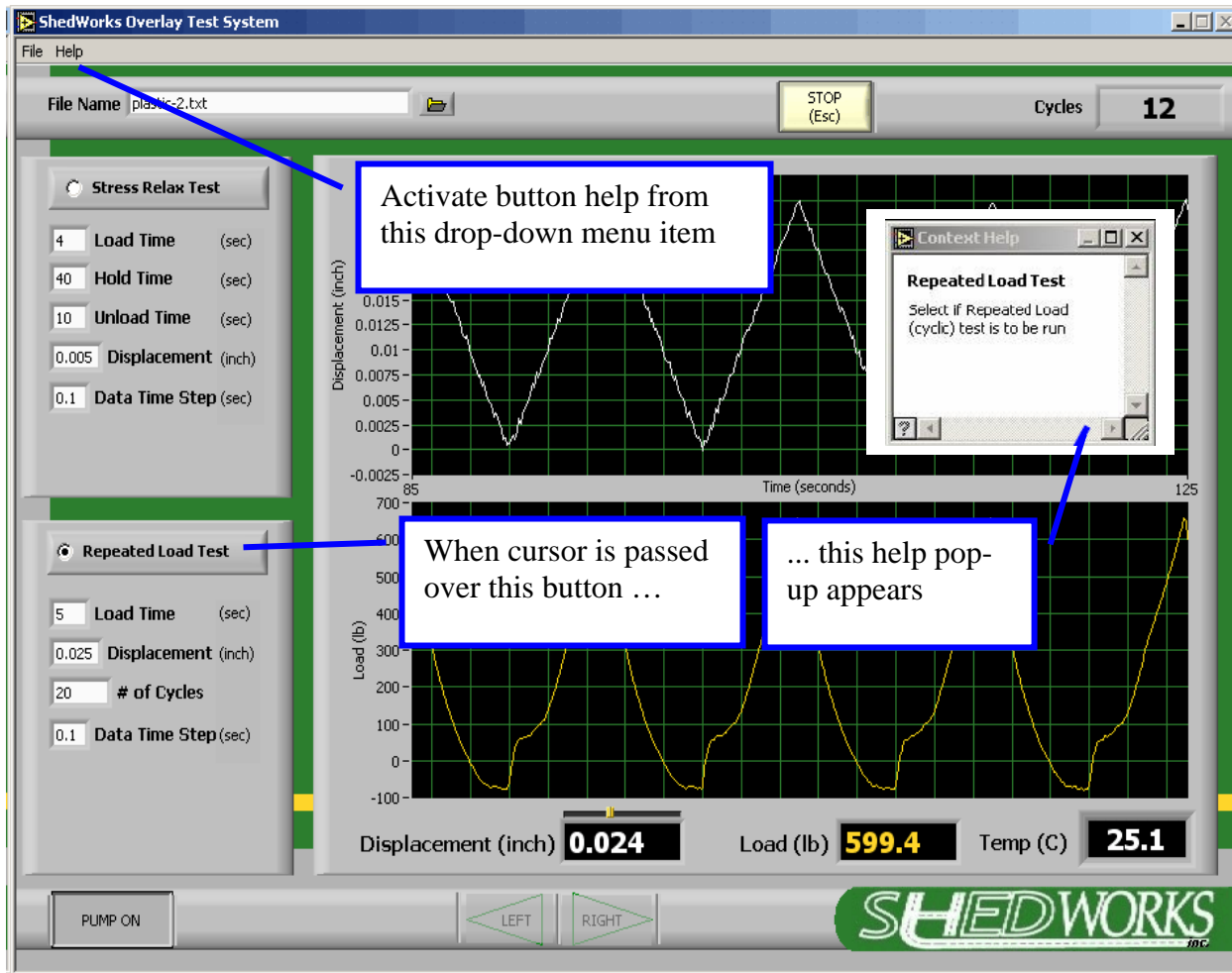

Figure 12. Button Help Pop-up Window.

Figure 13. General Help File.

This testing machine is a feedback controlled testing machine. In basic terms, this means that the machine continually looks at the difference between what the operator has told it to do and what it is actually doing, and immediately tries to correct any difference to reduce it to zero. It does this by looking at the transducer used for controlling the machine at a high sampling rate that is hardware-dependent (i.e., in the kHz range – note: this feedback loop closure rate is not controllable by the user, only the data acquisition rate for data collection and storage can be changed by the user in the data time step field on the software test screen). The standard test here is displacement controlled, so it is looking at a Linear Variable Differential Transformer (LVDT) mounted to the back of the two main machine blocks.

What happens when a difference between command and actual is detected is controlled by adjustable parameters in the software called proportional, integral, and derivate (PID) settings (Figure 14). PID setting determination is often more of an art than a science. Typically, the

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basic settings are found by trial and error, but there are systems that automatically adjust these values during testing. The PID settings affect how the machine responds and therefore are dependent on the material properties of the specimen being tested. Fortunately, there are two things that make PID settings a manageable task. One is that the values do not need to be perfect to achieve acceptable machine control performance, and the second is that most of the effect on control comes from only one of the numbers, P. In this system, with no specimen in the machine, P=20 is usually a reasonable value. However, when running a good asphalt mix in the machine, P=80 seems to give good performance.

The PID settings for the LVDT and the Load Cell are located in the test preferences screen, which can be found in the drop-down menu. U.S. and metric units can also be selected in this screen. If column headings are not desired in the output data file, they may be deleted here. A criterion for automatically stopping the test can be specified in terms of load drop. As the material is damaged in displacement control, the load will drop. The magnitude of the drop can be used to automatically stop the test before complete failure by checking the radio button and entering a value in percent.
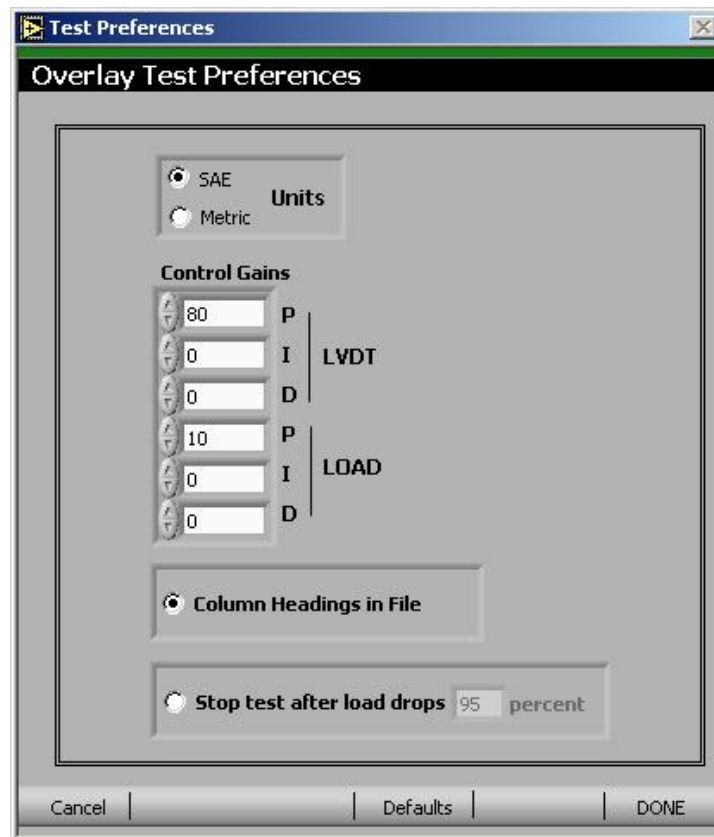

Figure 14. Test Preferences Screen.

EMERGENCY OPERATIONS

In the event of an emergency, the primary method of terminating machine operation is by pressing the red Emergency Stop mushroom button located on the control panel. Pushing the switch disconnects power to the machine from the supply line (however, power is still present inside the machine).

If the power upstream of the entry box needs to be disconnected, unplug the machine or disconnect the circuit at the building's service panel (e.g., building's circuit breaker or fuse panel).

MAINTENANCE AND ADJUSTMENTS

Most of the machine is low maintenance. Some components are not corrosion proof, and running at cold temperature in high humidity areas often creates condensation on the parts. Of particular interest are the linear bearings and shafts. Inspect these items frequently.

Maintenance

- Check the grease on the main bearings and shafts daily. Apply new grease if necessary.
- Check hydraulic oil level at least every 6 months. Refill with hydraulic oil as needed (ISO 46 or other readily available hydraulic oil).
- Replace the hydraulic oil filter at least once every 3 years in normal lab operations. In dirty environments or very high production labs, inspect and change more often as warranted.

Recommended lubrication products are available from the manufacturer or locally through auto parts stores, retail stores, and industrial supply houses.

- For general oiling, use LPS-2.
- For cleaning metal parts, use WD-40 if long-term lubrication is not necessary. However, if WD-40 is used to clean the linear shafts, make sure you then clean the WD-40 off the shafts before applying grease.
- Use something like rubbing alcohol to clean parts that need to be clean but not oily.
- For greasing of the main bearings and shafts, use Slick One Grease.
- For cleaning the clear polycarbonate window, use Meguiar's Mirror Glaze plastic cleaner and plastic polish. Do not use any other cleaning products on the polycarbonate.
- For general cleaning of the aluminum and opaque plastic paneling, you can use a number of cleaning products such as Windex. The green panels are UHMW and are very durable and impact resistant. This is the same material often used to line truck beds for hauling rock. Some dents and scratches in the UHMW will inevitably occur, but the material should take punishment better than many other materials. Virtually nothing will stick very well to it.

Adjustments

NOTE: All fasteners on the machine, with the exception of some of the frame mounting screws (flanged nuts, frame screws, wheels, and leveling feet), are U.S. customary

hardware. The leveling feet can be used to level and stabilize the machine after it is moved into place in the laboratory.

Hydraulic pressure may be adjusted at the valve inside the lower part of the machine. Contact the manufacturer if adjustment is desired. PID adjustments to alter machine performance may be accomplished through the software as previously discussed.

The LVDT on the rear of the machine may be adjusted to alter the reading at rest. This should not be necessary but is possible by loosening the small (1-72) lock nut and turning the small all thread in the desired direction while watching the digital display on the software. Calibration and zero offset requires access to the signal conditioners inside the lower portion of the machine. Contact the manufacturer for assistance.

Temperature set point adjustment is performed by simply pressing the up or down arrow on the temperature controller until the desired set point is reached. Although the controller is also a PID control system, it should not be necessary to access the programming features of the controller under normal operations. The feedback to the controller is a small RTD element located in the right-hand portion of the environmental chamber in the return air flow.

TROUBLE-SHOOTING

- System grinds/chatters
  Change PID settings, usually decreasing P will stop valve noise and rough-shaped waveforms.
- Rounded waveform not reaching requested peaks:
  If the requested waveform is not supposed to be rounded, but is actually coming out that way, it will often be the case that it is not reaching the requested peak value either. Increasing P will usually solve this problem.

SPECIFICATIONS

Approximate dimensions: 33"W x 30"D x 44"H
Electrical power required: 110VAC, single phase

WARRANTY

Warranty: Except for expendable components such as oil filters, and except for corrosion, normal wear and tear, and unauthorized Purchaser modification; all parts and labor are warranted to be free from defects for a period of 12 months from date of sale. Liability is limited to refund, repair, or replacement at the Manufacturer's option.

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DRAFT SPECIFICATION FOR MIX ACCEPTANCE USING THE OVERLAY TESTER

Based on extensive laboratory overlay testing on typical TxDOT's mixes under different temperatures and on field cores with variable performance of reflective cracking, the draft specification for mix acceptance is preliminarily recommended as follows:

Reflective cracking life @77 ºF (25 ºC) and 0.025 in (0.63 mm) opening > 300 cycles