Racing Surfaces Testing Laboratory

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LABORATORY TEST METHOD FOR VERTICAL MODULUS DETERMINATION OF RACING SURFACE SOIL MATERIALS

Note:

The sample compaction method described in ASTM 4767 (Standard Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils) is utilized instead of the Procter method due to the close proximity of the lower ultrasonic transducer to the configuration of the test setup.

1) Place at least 600g of material in oven at 110°C +/- 2°C to remove moisture. If there is enough material, dry an extra 600g to have for backup. Refer to the moisture removal procedure for details. Do this at least 24 hours prior to the test.

2) Turn on the **air compressor**.

3) Record the mass of a clean **sample pan** using a **scale accurate to ±0.1g**. Transfer approximately 500-600g of the dried sample material to the sample pan.

4) Add the desired forming moisture content of 8%, 10%, 12%, or 14% using a spray bottle of **distilled water**. If only one test is to be done, use 12%. Mix thoroughly until the moisture becomes uniform throughout the mixture and there are no clumps of material.

5) Put a clean **tamper** and clean **spoon** into the sample pan. Weigh the sample pan and record this weight on the datasheet as Initial Weight of Container.

6) Using the spoon, transfer approximately 160 g of material to the **sample cylinder**. Try to distribute the material evenly across the bottom of the cylinder. Tamp the material 25 times. To keep the sample as level as possible while tamping, move the tamper around circumference and center of the cylinder. Transfer another 160 g and repeat the process. By the third layer, the total mass of the sample in the cylinder should be about 500 g.

7) Weigh the sample pan and record the weight as "Final Weight of Container."

8) Measure the vertical distance from the top of the sample to the top of cylinder opening in mm—take 4 measurements around the circumference and average. Record as initial thickness. The datasheet will automatically subtract this from the cylinder height (184mm) to find the starting thickness (usually around 34mm).

9) Carefully tilt the cylinder and slowly insert the **upper plunger** that contains the **upper ultrasonic transducer**. Make sure the black wire from the ultrasonic transducer is in the groove along the edge of the plunger. Be sure contact is made between the cylinder and the sample (gently).

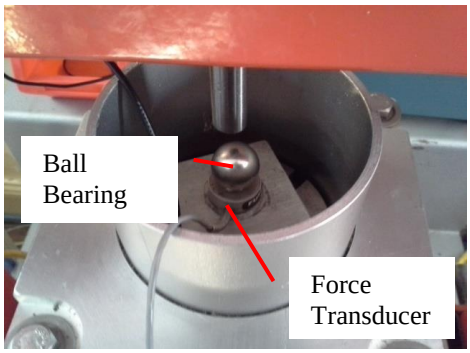
10) Open the valve on the back of the **Bimba air cylinder**. Push up on the bottom of the air cylinder until it is at the top of its motion and close the valve.

11) Move the assembly to the orange **test frame** and connect the upper transducer wire to the **Pulser box** in the "T/R" transmit receiver port.

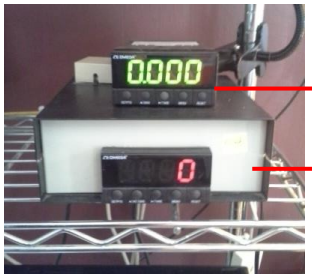
Connect the **lower transducer** wire to the left port in the **ultrasonic preamplifier box** (preamp).

Be sure the wire from the "out" port on the preamp is connected to the left-side "Channel 1" (CH1) port of the **oscilloscope**. Also, be sure the wire from the back side of the pulser is connected to the right-side trigger port of the oscilloscope (EXT TRIG).

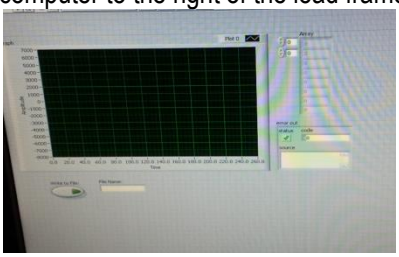
12) Place **force transducer** (grey wire) on the upper plunger using vacuum grease. Center the force transducer by sliding the rectangular aluminum block at the top of the upper plunger. Place a **2 cm bearing ball** in the center of the transducer. Be sure not to crimp the wire and make sure it is connected to the black **load indicator box**.



13) Power on both the load and the **displacement indicator boxes** (use the switch on the power strip on the back of the computer shelf). Zero the load indicator ('tare' button). Power on the oscilloscope, use preset settings (if these are not correct press 'save/recall setup', 'recall saved setup', 'recall setup2 user', 'clear menu').



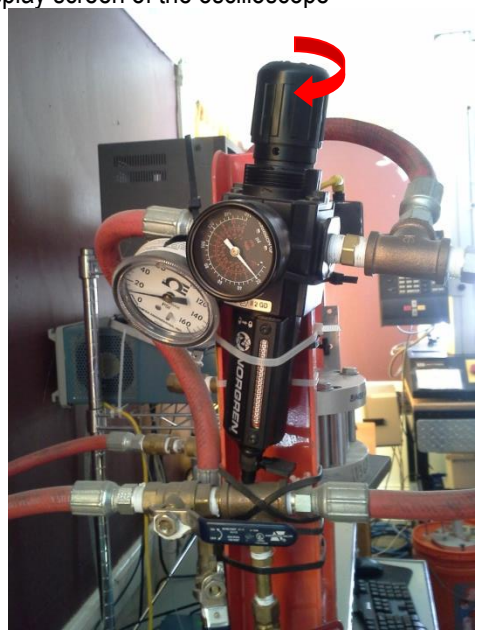
14) Start the tangent modulus Labview program on the computer to the right of the load frame (either file is fine).



15) Carefully center the sample cylinder setup and slowly lower the air cylinder and **piston rod assembly**, turning the **constraining bolts** until the bottom of the rod just makes contact with the force transducer—keep between 1 and 0 pounds. Tighten the upper and lower constraining bolts.

16) Attach the **string potentiometer** under the edge of the air cylinder. Try to keep the string as close to vertical as possible. Tape may be used to secure the potentiometer. Zero out the displacement indicator ('tare' button).

17) Holding a **stopwatch**, open the **pressure regulator** to pressurize the system and apply 193 lbs for the first loading (the plunger assembly weighs 7 pounds). Monitor the force and displacement displays; they should be increasing accordingly. Once 193 lbs is reached*, start stopwatch and record displacements at the time intervals described in the data sheet. You should note a signal on the display screen of the oscilloscope



18) After 20 minutes, steady state creep conditions should be met. Adjust the 'VOLTS/DIV' dial on the oscilloscope so that the signal fills the screen, but is not cut off on the top or the bottom.

19) In Labview, enter the file name in the format MODULUS_DIRT_TRK_PROJ#_LOC_#PCT_#C_LOAD and hit the run button (top left corner). Then click write to file.

20) The file will be saved to the folder Desktop>JB Ultrasonics>DATA. Some numbers will have been added to the end of the file name. Remove the numbers and move the file to the project folder.

21) To find the Trig t thru track, first open the data file. Copy and paste the numbers into the cross correlation data sheet (CRCORR), starting in row 28 in the column for that load (200lb is in column B). Copy again. Put the numbers in row 15 of the CRCORR data sheet using paste>paste special>transpose. This will take the column and make it a row.

22) datasheet into the cell Trig t thru track in the Modulus data sheet.

23) Once the data are collected at 193 lbs (actually 200 lbs), increase load to 393 lbs (400 lbs) and follow steps 17

and 18. Do the same for 593 lbs (600 lbs), 793 lbs (800 lbs) and 993 lbs (1000 lbs).

*NOTE: double check the load by observing the pressure gages. Due to the 4 inch inner diameter of the diaphragm in the Bimba air actuator, the pressure is approximately:

P = F(A), with area = (3.1416/4) (4^2) or 12.56 in^2, there will be some variance between the gages.

200 lbs = 15 psi

400 lbs = 31 psi

600 lbs = 47 psi

800 lbs = 63 psi

1000 lbs = 79 psi

24) Once the data for 200, 400, 600, 800 and 1000 lbs have been collected, use the pressure regulator to reduce the pressure in the system to zero.

25) Loosen the constraining bolts and lift the piston rod and Bimba air cylinder.

26) Carefully detach the ultrasonic transducer wires that connect the aluminum sample cylinder in the orange test frame to the pulser and preamplifier electronic units. Also, detach the load cell from the top of the cylinder.

27) Take out the sample cylinder from the test frame and carefully tilt the cylinder and remove the upper test plunger that contains the upper ultrasonic transducer.

28) Remove the sample, clean out the cylinder with a damp cloth, and dry. Keep the **lower aluminum disk** in place. Be sure the inside and outside of cylinder are completely dry.

Revision No.	Date	Revision By	Description
1.0	01-NOV-2010	L. Flanders	Modified for dirt testing
1.1	26-Dec-2011	M. Segee	changed step 11, datasheet automatically finds sample height added cross correlation directions
1.2	23-Apr-2012	M. Segee	changed row number for cross correlation from 20 to 15, clarified steps.
1.3	10-Dec-2012	A. Eguren	Clarified step 15
1.4	9-Jul-2013	M. Segee	dry 600g for backup, not 1200, clarified steps
1.5	22-Aug-2013	M. Segee	clarified steps
1.6	3-MAR-2014	T. Thomson	Added photos