Instron 4201 Updated Condensed Operating Manual

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1 Introduction

As of May 2008, the IBM PC XT that once controlled the Instron 4201 has been replaced by a newer, faster PC, and the old proprietary Instron software has been replaced by a very lightweight LabVIEW VI that performs the same basic functions. This manual details the steps and procedures to take to perform a successful tensile test on an ASTM polymer test sample.

2 Setting Up the System

Shown in Figure 1 is the Instron 4201 Test Stand as seen when first approached by the user.

Figure 1: Instron 4201 Test Stand

The user will need several items to complete the test successfully: An ASTM test sample, a strain gage extensometer, and a socket wrench to tighten the bolts that will hold the test sample in place. Figure 2 shows the extensometer used with the 4201. It is an Instron 2630-037 Strain Gage Extensometer. **It is very sensitive and very fragile and should be handled with great care.** Once these items are obtained, the test can continue.

Figure 2: 2630-037 Strain Gage Extensometer   Figure 3: Extensometer Connector

2.1   Test Stand Setup

Make sure that the power switch on the test stand is in the **OFF** position. This is important since the test stand determines if the control center is on or off. The user will first need to connect the extensometer to the free parallel port lying beside the test stand as shown in Figure 3. The power can then be turned on.[1] After that, the sample is put into place on the test stand. The clamps are fastened as close to the center of the sample as possible, but only on the wide ends of the sample. Loading the sample improperly will result in erroneous stress and strain data, as the test stand will be stretching parts of the sample that do not pertain to the measurements being taken (i.e. the wide ends of the sample). The extensometer is then placed on the sample. The two "tongs" of the extensometer should be as close as possible to each other (in this case, 2 inches apart) so that the strain measurements are accurate. The final setup can be seen in Figure 4.

The sample being used throughout this manual is a polymer, polypropylene, obtained from the machine shop. Any polymer will work in the system, although the sample will usually be either Low Density or High Density Polyethylene (LDPE and HDPE, respectively). Due to the load cell being used, the current system can only test polymers as the load cell is only rated for 1000 pounds of force.

2.2   Control Panel Setup

After the test stand is set up, the control panel is now ready to be set up. To begin, make sure that the light above the IEEE button, shown in Figure 5, on the right side of the console is not lit.[2]

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[1]The extensometer is self-identifying on the system, so if it is plugged in after the system is already powered up, it will not function correctly.

[2]In IEEE mode, most of the buttons on the control panel will not work since in this mode, the system is being controlled by an external source via an IEEE-488 bus. The user will know if the control panel is in IEEE mode if none of the buttons work and the display above the IEEE button displays "IEEE" when a button (other than the IEEE button, of course) is pushed.
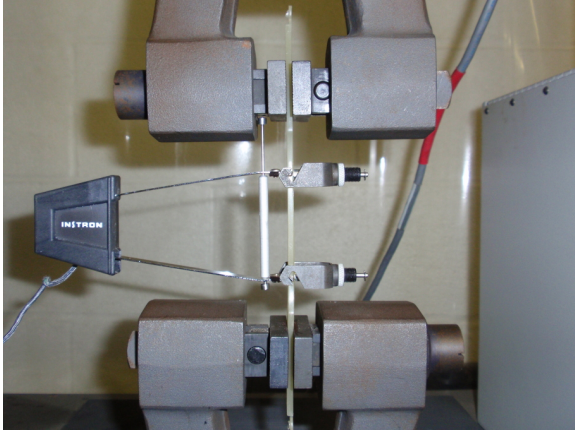
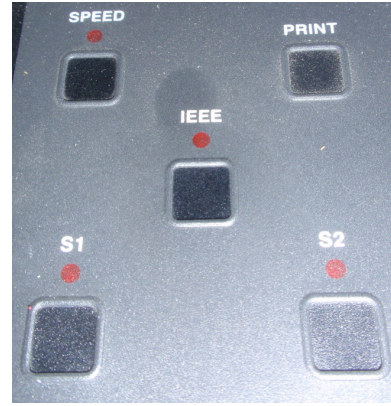Figure 4: Final Test Setup Before Stretching

Figure 5: IEEE Control Button and Indicator

Then, the load cell and extensometer must be calibrated. Thankfully, they are both electrical and self-identifying so the process takes only about 15 seconds. The calibration is done by finding the "Load Cal" and "Strain Cal" buttons on the left side of the console (shown in Figure 6). These buttons will zero the load and strain measurements. To zero the Load Cell, press "Load Cal" and then the "Enter" key in the middle of the console. To zero the extensometer, press "Strain Cal" and then the "Enter" key again. Each calibration should take about 6 seconds. A separate command embedded in the VI will reset the extension value, which is very important to calculating the strain experienced by the sample.

Figure 6: Load and Strain Calibration Buttons

After the load and strain sensors are calibrated and zeroed, the IEEE button should be pressed to relenquish control to the LabVIEW VI which communicates over an IEEE-488 bus.

2.3   LabVIEW Setup

After the test stand and control panel are set up, start up the VI which will perform the experiment. The VI used is called TensileTest.vi. It should be located in the `C:\Instron` directory. Once the VI is loaded, the user should see Figure 7, the VI Front Panel. In the upper left corner, there is a box labeled inputs. There are 4 inputs needed for the VI to work: Cross-sectional area (A_c), Maximum Load, number of data points, and crosshead speed. The defaults for each of these inputs are, respectively: 0 in^2, 900 lb, 100, and 0.2 in/min.

Maximum load and crosshead speed should be kept as is, but the number of data points and cross-sectional area should be changed. The usual cross sectional area for an ASTM test sample is $0.0625\ in^2$. This should be checked however since not all samples are alike. The number of data points can be changed relative to how much the user wants to know about the sample. As the number of data points increase, so does the length of the test and the extent to which the sample is stretched. If the user wants to know at least the yield strength, 100 data points will suffice. However, if more wants to be known about how the sample reacts to being loaded to a point past its tensile strength, then 300 data points would be more appropriate.

Then, in the bottom left corner of the VI, find the text box with "Write to File" above it and enter a filename such as `C:\Instron\<polymer_name>_<date>_<trial_#>.txt`. The data gathered in this file will be manipulated to obtain the Young's Modulus, Yield Strength, and Tensile Strength of the material via MATLAB. Figure 7 shows how the VI should look after the inputs have been entered.
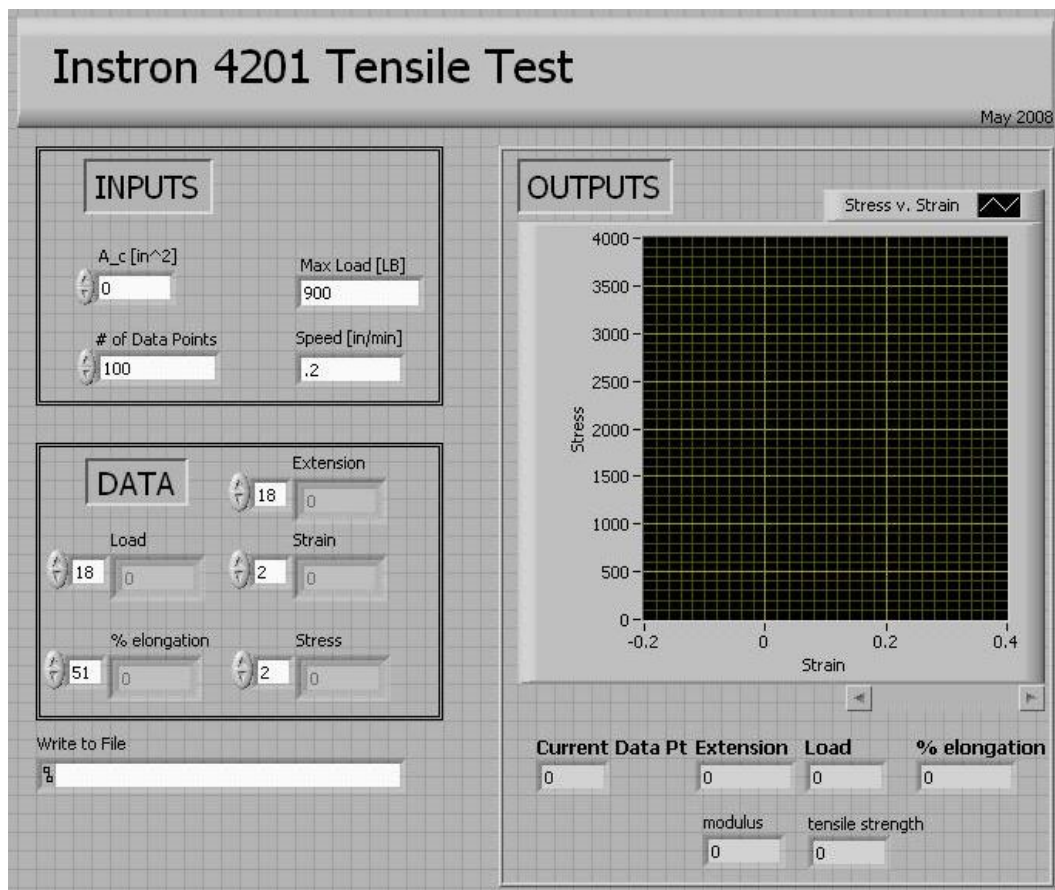

Figure 7: Instron VI Front Panel before Test

After the sufficient inputs have been entered, make sure that the IEEE button is lit (from Figure 5), start the VI, and let it runs its course. A graph showing stress versus strain will appear after the test has completed.

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