

Analog Servohydraulic Test Machine Controller Procedures

EMA 611 Advanced Mechanical Testing of Materials, University of Wisconsin

1 **Set up.** Connect a digital oscilloscope to the controller. Connect channel 1 to the stroke (displacement) output. Connect channel 2 to the load (force) output.

2 **Turn on controller.** Turn on the controller using the black rotary switch, lower left. Choose the feedback control mode, stroke (displacement), load or strain. We begin with displacement control. Press the corresponding indicator light, middle left.

3 **Zero channel.** Turn set point dial to 500 on a scale of 1000. Look at the analog meter on the front panel: this meter displays the error signal, the difference between the program signal and the actual value of the controlled variable such as displacement. Swing the front (outer) panel out to reveal more controls behind it: an inner panel. These controls are used to set up a test. If you are in stroke (displacement) control, adjust the zero knob so that the analog meter reads zero. Turn the knob in the opposite direction as the needle in the meter. Do not turn on hydraulics until this zeroing is done. Press the blue reset button at bottom; also press interlock reset to shut error indicator and allow hydraulics to activate. **Warning:** the grips may move suddenly when the hydraulics come on unless you have zeroed channels first. Keep hands and other body parts away.

4 **Turn on hydraulics** as follows. Press hydraulics low, then hydraulics high. When hydraulics come on, you can hear the driver motor in the back room. **Warning:** the grips may move suddenly when the hydraulics come on unless you have zeroed channels first. Keep hands and other body parts away.

5 **Grips.** Hydraulics must be on for the grips to work. Use levers to control open and close of grips. Grip force is large. Keep hands away when engaging grips. When installing compression or bending fixtures, use a metal spacer so the metal tang does not go into the grip all the way, otherwise it may stick. Install the lower fixture first, then place the upper one on it to align, then install the upper one; tighten the grip on the protruding tang.

6 **Range.** For load, the 100% range, set via the inner panel, corresponds to $\pm 20,000$ pounds. The corresponding analog signal is ± 10 volts into the scope. Use the 10% range, 2,000 pounds for 10 volts. For stroke (displacement), the 100% range corresponds to ± 5 inches. The corresponding analog signal is ± 10 volts into the scope.

7 **Displacement control input.** Practice controlling the motion of the test frame in displacement control before mounting a specimen. Set point controls the static motion of the grip. Span controls the amplitude of a dynamic waveform. Use the function generator to generate a sinusoidal waveform at 1 Hz. Start at zero span (span 1) so that you can gradually increase the amplitude. Press start to begin waveform. When you

are done, return the set point dial to 500 on a scale of 1000.

8 **Mount a specimen.** Use the zero control in the inner panel to move the grips to contact the specimen. Use the 100% range for stroke (displacement) to obtain enough motion. **Warning:** there is electronic noise in turning the knob so the motion may be jerky. If the hydraulics turn off from this noise, turn them on again. After mounting the specimen use the 10% range, so the maximum displacement is ± 0.5 inch. Observe that using the internal zero knob does not change the displacement signal on the scope. That is beneficial because the initial contact condition is a sensible zero for the displacement scale.

9 **Safety and limits.** Use tongs rather than hands when possible to mount specimens. If your specimen is brittle, use a plastic shield to prevent injury from flying fragments. Use safety glasses to prevent injury from broken pieces. Only one person should be involved in mounting a specimen. **Everyone else keep away from the controller.** If the system starts to move before everyone is clear, you may hit the red panic button. One can set limits to the allowable force or displacement via the inner panel.

10 **Testing.** Use the **function generator** controls to generate the desired waveform. The function generator is capable of sine, square, and ramp functions. A haversine is a sine function with a DC offset so that the maximum or minimum is zero rather than the center point. These are useful in compression tests to prevent loss of contact or in tension tests to prevent a compression phase that can cause buckling.

11 **Testing: digital output.** The digital oscilloscopes are capable of digital display of amplitude, peak to peak, average, etc. on the scope face. If that suffices, use the measure control on the scope to display these data, then write them down. For digital data output, the newer oscilloscopes allow data to be saved to a USB flash drive. If you use the older digital scope, plug an ethernet cable into the back. Data are then obtained by pointing a web browser (within the engineering firewall) to the IP address shown on the scope and following the instructions on the page. Save each channel separately; the data are voltage vs. time.

12 Check your saved digital data by opening the file with a text editor such as note pad. Make sure you have both channels.

13 **Shut down procedure.** To shut down, turn off hydraulics first, then turn off the controller. Write the time you have used the frame on the paper sheet on the clipboard.