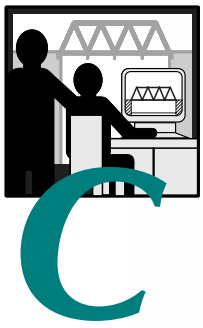


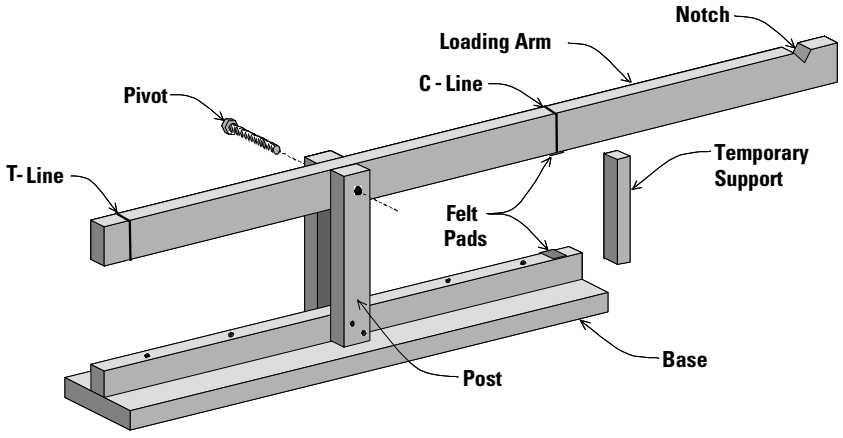
Appendix C

Building the Testing Machine

Description

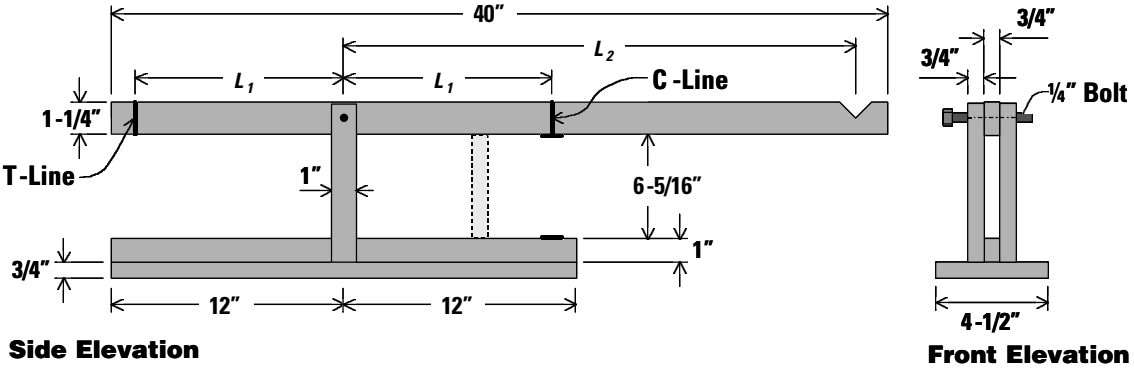
This simple, lever-based testing machine is designed to apply a controlled tension or compression force to a cardboard test specimen and measure that force with reasonable accuracy. Its use is described in Learning Activity #2. Only a moderate level of woodworking skill is required to build it.

The configuration and component parts of the testing machine are illustrated in the drawing below. The *loading arm*, *posts*, and *base* are made of wood. Pine was used on the original device, but any wood will do. The posts and base are all connected together with glue and woodscrews, while the loading arm is fastened to the posts with only a single steel bolt, which serves as a pivot. The arm should be free to rotate about the pivot. The *T-Line* and *C-Line* are vertical marks on the loading arm, indicating the points where the tension and compression specimens will be fastened for testing. *Felt pads* are glued to the underside of the loading arm and the top side of the base at the C-Line. These pads will ensure that compression test specimens are uniformly loaded. The *temporary support* is a wooden post that is used to support the loading arm while a tension specimen is being clamped into position.



Isometric View of the Testing Machine

The drawing below shows the dimensions the testing machine, in inches. Of all the dimensions provided, only the 6-5/16″ distance between the loading arm and the base must be exact. (This is just slightly larger than 16 centimeters, the length of our longest compression specimens). All other dimensions can be adapted to the sizes of available lumber, storage space requirements, etc. The dimension L_1 is the distance from the pivot to the T-Line *and* from the pivot to the C-Line. The dimension L_2 is the distance from the pivot to the center of the notch. These dimensions will be determined during the process of balancing the loading arm, as describ below.



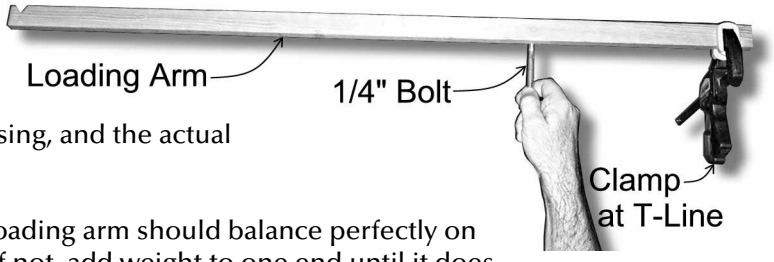
Elevation View of the Testing Machine

Test specimens will be fastened into the testing machine with two woodworker's clamps. 6″ Quick-Grip® clamps are highly recommended. These clamps are available at most hardware stores. They work well for this project, because they can be put in place with one hand, and their rubber pads are very effective in preventing the test specimen from slipping.

Balancing the Loading Arm

To get accurate experimental results from the testing machine, the loading arm must be properly balanced. The objective of the balancing process is to ensure that the weight of the arm does not place any load on the test specimen. It is best to accomplish this task during construction, before the hole for the pivot is drilled in the loading arm. Here's how to do it:

- Cut the loading arm to size, and cut out the notch at one end.
- Mark the T-Line about 2 centimeters from the end opposite the notch.
- Place one Quick-Grip® clamp on the T-Line. Ensure that the clamp is centered on the line.
- Using the ¼″ bolt that will eventually be used for the pivot, find the point where the arm (with one clamp attached) balances perfectly. See the photo below.
- Mark the balance point, and drill a ¼″ hole for the pivot through the center of the arm at this location.
- Measure L_1, the distance from the T-Line to the pivot hole. Then measure the same distance on the opposite side of the pivot, and mark the location of the C-Line.
- Finally measure L_2, the distance from the pivot to the center of the notch. Record both L_1 and L_2 for future reference.



On the original testing device, L_1 was 25 cm and L_2 was 69.5 cm. However, these dimensions could vary substantially, depending on the weight of your clamp, the type of wood you are using, and the actual dimensions of your loading arm.

Once the testing machine is assembled, the loading arm should balance perfectly on the pivot, with one clamp attached at the T-line. If not, add weight to one end until it does balance.