EK 305 – Mechanics of Materials
LAB #4 – Beam Buckling
TF Laboratory Procedure

(Revised by Luke Colby, Kris Pelletier, Prof. Isaacson, and Prof. Barbone
July 2002; Bridget Reardon May 2009; Kara Mogensen Fall 2011)

INSTRON SETUP

I. Check that Instron tower and PC are turned on.

II. Open software: Console, DAX

III. Check that coolant water is on

IV. Press and hold low power hydraulics button "I" until it powers on

V. Press hydraulics button "II"to switch to high power

VI. Move the lower load cell up to zero position **making sure it will not collide with the upper load cell**

(a) How to move lower load cell, two methods:

Note: "negative" directions cause the lower load cell to move up where "positive" directions move the load cell down

1. Press the up arrow button on the remote control pad on the Instron machine, for fine movement use the black scroll wheel on the same control pad, until you reach 0.00mm on the position readout on the panel or software
2. Or measure to make sure that the upper load cell is at least ??mm from the base under the lower load cell and in the Console software go to Immediate Set Point 0.00mm and press "enter" on the keyboard. **Be very careful with this tool** you never want to set the lower load cell to a location that would cause it to strike the upper load cell!

VII. Install appropriate jaws or fixtures

(a) How to install jaws:

Note: as these are greased with Molykote disposable gloves are recommended for handling.

1. Slip the springs off the pins on the jaws in the machine now and remove them one by one; make sure that you hold each upper jaw as you remove its springs so it does not fall.
2. Before inserting the new set of jaws wipe them clean and lightly coat the slanted back face with Molykote.

3. Slide the new jaws in from the base and connect the springs to the spring pins on the jaws making sure they are seated well in the grooves on the pins.
4. Wipe each removed jaw clean and store.

(b) Use the straightening tool (a metal bar of appropriate length to span both grips) to align the lower load cell with the upper load cell by clamping it into both grips. **The lower load cell will spin by hand movement or when moving the load cell without a specimen loaded so you will have to realign it before each test.**

(c) How to install pinned-pinned fixture:

1. Install the large span 0.3125”-0.625” jaws.
2. Balance the load.
3. Slide the bottom fixture between the jaws with the curved U-shaped side facing toward the operator and the small screwed on plate facing the rear of the machine. Line up the fixture such that the edge is flush with the jaws. This ensures the fixtures are parallel. Press the close button for the bottom grip. Do the same for the upper grip. See Fig. 1.

Figure 1. Pinned-Pinned Fixture Setup in 0.3125”-0.625” Grips

VIII. Move the upper load cell to the appropriate position for the length of sample

(a) How to move upper load cell:

Start with the lower load cell at its lowest limit (this is the default position when Instron is first turned on) and make sure nothing is obstructing the movement of the upper load cell structure.

1. Spray the two support columns lightly with WD-40
2. Loosen the yellow safety guards around the pistons (Allen/hex key required).

Figure 2. Safety Guards

3. Turn the “Clamp/Unclamp” knob counterclockwise a small amount.

Figure 3. Manual Clamp Valves

4. Compare the size of your sample to the current upper load cell location and decide if you would like to move the load cell up or down.
5. The “Raise” knob will move the upper load cell up towards the ceiling and “Lower” knob will move the load cell down towards the lower load cell. Choose the appropriate knob and turn it counterclockwise slowly. It may take a moment for the pressure to build so move it a small amount and stop, wait, if the upper load cell is not moving then turn the knob a little more and wait. The more you open this clamp the faster the head will move and we have to be very careful here as we do not want it to move uncontrollably because it poses a danger to the operator and the equipment so only open it as much as needed for movement to occur.

6. When the upper load cell moves to your desired position turn the knob clockwise to stop motion. Then reclamp by turning the "Clamp/Unclamp" knob clockwise.
7. Tighten the yellow safety guards around the pistons.

IX. How to run the Instron Test

(a) Go To Instron Console software
   1. Balance Load
   2. Enable Position and Load limits

(b) Go To DAX software
   1. Open Default.tst
   2. Data Logging Window
      i. Sampling Rate **0.01 kHz**
      ii. Data File, Browse, enter file path and name, click Save
      iii. Press OK button to close
      iv. Press Start button and when prompted to "click YES to wait for the waveform generator to start or NO to begin data logging," click YES

(c) Set Ramp Generator for tests
      i. Relative Ramp
      ii. End Point: **-1.0 mm**
      iii. Ramp Rate **0.01 mm/sec**
      iv. Press START to run test
      v. To end test hit STOP in Console software
   2. When test is finished to remove the sample:
      i. Remove Limits
      ii. Go to Immediate Setpoint in Instron Console software type **0.0 mm** then press the enter key. **Take extreme care in this step to enter the correct value or the sample or Instron could be damaged.**
      iii. Align the lower load cell with the upper one for the next test; if the pinning fixtures are in the jaws you can remove them to straighten by closing the grips on the straightening bar and reinsert them or straighten by using a c-clamp to fasten the pinning fixtures to the straightening bar to align the grips

PART I PINNED-PINNED TESTS (EULER)
Samples: 0.125" x 1" x 13" Aluminum 6061-T6 and Steel 1018, rounded ends

I. Pinned-pinned fixtures required, complete following steps ("Instron Setup" for detailed instructions):

(a) Refer to Instron Setup I-VI: Turning on Instron, Software, Water, Hydraulics, Zero position

(b) Refer to Instron Setup VII: Install large span 0.3125"-0.625" jaws and pinned-pinned fixtures

(c) To insert the 0.125" x 1" x 13" Aluminum 6061-T6 sample with rounded ends in the pinned-pinned fixture:

1. Refer to Instron Setup VIII: Move upper load cell to proper height for the 13" length samples using the sample as a guide next to the pinning fixtures, **do NOT place sample in the pinning fixtures when moving the upper load cell**
2. The sample should fit loosely between the pins without force on it. If minor adjustment of distance is needed: open upper jaws and move pinning fixture down to an appropriate location, ensure fixture is aligned with jaw edge (so its parallel with lower fixture) and close jaws

Figure 4. Pinned-Pinned Loaded Sample

3. Follow Step IX of Instron Setup "How to run the Instron Test"

(d) Repeat step (c) for the 0.125" x 1" x 13" Steel 1018 sample with rounded ends

PART II FIXED-FIXED TESTS (EULER)
Samples used: 0.125" x 1" x 13" Aluminum 6061-T6 and Steel 1018, square ends

I. Complete following steps ("Instron Setup" for detailed instructions):

(a) Refer to Instron Setup I-VI: Turning on Instron, Software, Water, Hydraulics, Zero position (Confirm but this should be OK after previous test)

(b) Refer to Instron Setup VII: Install small span 0-0.3125" jaws and use straightening tool to align load cells vertically

(c) To insert the 0.125" x 1" x 13" Aluminum 6061-T6 sample with square ends in the grips:

1. Refer to Instron Setup VIII: Move upper load cell to proper height for the 13" length samples. The sample has a mark on it, place the marked side up and the unmarked side at the base of the grips in the lower load cell. Move the upper load cell such that the lowest point of the jaws lines up with the mark using the sample as a guide next to the jaws, **do NOT close sample in the jaws when moving the upper load cell**
2. Balance Load
3. Insert the sample unmarked side down into the bottom jaws and aligned with the edge so it is straight vertically, close jaws
4. Close upper jaws

Figure 5. Fixed-Fixed Loaded Sample

5. Follow Step IX of Instron Setup "How to run the Instron Test"

(d) Repeat step (c) for the 0.125" x 1" x 13" Steel 1018 sample with square ends

PART III FIXED-FIXED TESTS (JOHNSON)
Samples used: 0.125" x 1" x 5" Steel 1018, square ends

I. Complete following steps ("Instron Setup" for detailed instructions):

(a) Refer to Instron Setup I-VI: Turning on Instron, Software, Water, Hydraulics, Zero position (Confirm but this should be OK after previous test)

(b) Refer to Instron Setup VII: Install small span 0-0.3125” jaws and use straightening tool to align load cells vertically

(c) To insert the 0.125” x 1” x 5” Steel 1018 sample with square ends in the grips:

1. Refer to Instron Setup VIII: Move upper load cell to proper height for the 5” length samples. The sample has a mark on it, place the marked side up and the unmarked side at the base of the grips in the lower load cell. Move the upper load cell such that the lowest point of the jaws lines up with the mark using the sample as a guide next to the jaws, **do NOT close sample in the jaws when moving the upper load cell**
2. Balance Load
3. Insert the sample unmarked side down into the bottom jaws and aligned with the edge so it is straight vertically, close jaws
4. Close upper jaws

Figure 6. Fixed-Fixed Loaded Sample, Johnson

5. Follow Step IX of Instron Setup “How to run the Instron Test”