Instructions:

* Replace the highlighted areas in yellow above with your own name, section and group numbers and correct dates,
* Watch the corresponding lab demo videos, review related materials in lecture notes, lab manual and other related documents,
* Provide your best answers to the following questions. Add pages as needed,
* Convert this Word answer sheet into pdf format and submit to Canvas.

1. (15 points) Provide your own account about strain gage: what it is, how does it work and how will it be used in this lab.
2. What are the gage factor (3 pts) and resistance (3 pts) of the gage used in this lab? Specify your source.
3. (10 pts) Describe the general procedure of gage installation.
4. (4 pts) According to the lab manual, how much glue will be applied in gage installation?

Total 35 points

Answers:

1. A strain gage is a small testing device that we attach to the surface of a material to determine its mechanical strain by measuring the change in electrical resistance in the device when the assembly experiences stress. Whenever the specimen is subjected to tension, the resistance of the strain gage increases; Similarly, when the specimen is subjected to compression, the resistance of the strain gage decreases. By collecting and processing this data of change in resistance, a software can measure the strain the material is experiencing. If the strain gage is submitted to lateral forces, the strain gage won’t experience any change in resistance, therefore it can’t measure lateral strain (relative to the positioning of the device). In this lab, we will subject our prototype to bending and tensile tests in order to determine the aluminum specimen’s mechanical properties such as the Young’s modulus.
2. The TA will inform us of the exact gage factor and resistance specifications of the strain gage provided to our group. In the demo video, it is said that the range of the possible GF will be from 2.05 to 2.15. From the Strain Gage Datasheet pdf file, the nominal resistance is of 350 for the SGD-5/350-LY13 model.
3. General procedure:
   1. Get the aluminum specimen from the TA and remove its protective plastic film from both sides.
   2. Mark the center of the specimen on both sides of specimen surface.
   3. Prepare the surfaces on both sides through a series of degreasing, sanding, and cleaning:
      1. Use sandpaper to lightly roughen the area where the strain gages will be installed, an area about twice the length of the strain gage in both directions. Use a 200 to 400-grit sandpaper. Do the sanding in a circular motion.
      2. Wipe off the dirt and dust using cleaning paper; only wipe in single direction and use fresh cleaning paper in each pass.
      3. Further clean up the sanded area with the degreaser.
      4. Do a final deep cleaning using swabs.
      5. Also clean up the glass slide which we will use for transporting the strain gages.
   4. Obtain one strain gage from the TA. Take notes of the exact gage factor and resistance specifications. Use a tweezer to take out the strain gage from packaging and place it on the glass slide.
   5. Cut a strip of the tape about the same two inches width of the specimen. Fold in the sticky side end to end to form a non-sticky plastic patch. Cut another tape strip about the same length. On both ends, fold in the sticky side about a quarter inch to form a non-sticky tab.
   6. Use the second tape modeled to pick the gage up from the glass slide by a light tap directly on the gage. Make sure the gage and the tape are aligned.
   7. Carefully fine the strain gage position and orientation so it is directly above the marked location in the center of the specimen and the long side of the gage is parallel to the long side of the plate. Pres down lightly the tape to the surface. If the orientation is not good, peel the tape off and retry.
   8. Grab and slowly peel off one end of the tape until the strain gage just comes off the specimen.
   9. Apply one tiny drop of 496 bonder glue to the specimen surface under where the gage will be located. Pull the lead wires of the gage up and smoothly push the tape back.
   10. Grab the first tape modeled in step (e), place it on top of the tape over the strain gage, and press down on the gage with a fingertip. Some excessive glue might get squeezed out from under the tape. Hold firmly for 2 minutes to allow the adhesive to set. Make sure not to glue the wires to the plates.
   11. Remove the top tape then remove the bottom tape very cautiously and slowly. Try not to make an angle when removing the bottom tape, to avoid peeling off the strain gage together. Remove tape and glue residues without touching the strain gage.
   12. Tape the specimen surface area under the lead wires to prevent them from touching the metal surface. Tape over the gage with a strip of non-sticky face of tape.
   13. Obtain from the TA and install the second strain gage on the other side of the plate by repeating steps (b) to (l). Pad a layer of paper under the specimen to protect the installed strain gage from the table.
   14. Next steps are to solder the connecting electrical wires together with the lead wires of the strain gages.
   15. Cut two red or black 28 awg electrical wires about 18” long and strip about an inch from all ends. Cross the end of the electrical wire to the gage wire, at about half inch from the end of the electrical wire and about ¾ inch to the strain gage. Set the two wires parallel and twist them together. Make sure to have about half an in bare lead wire left.
   16. Repeat (o) for the other gage wire.
   17. Turn the solder station on and set the temperature to 650oF. Start the soldering process by cleaning up the iron tip with the wet sponge and make sure the iron tip was properly tinned. Then hold the solder in place on the front side of the twisted joint and melt it with the iron tip touching the backside of the joint. Promptly “brush” through the joint with a thin coat of solder. Repeat the same for the other twisted joint.
   18. Remove the solder iron so the soldered joints can solidify. Once they cool off, pull them slightly to check if they are well connected. Trim off any remaining bare ends of the joints.
   19. Pull the joints apart to form a V shape and tape them down onto the tape insulation.
   20. Tape about 1 inch down of each electrical wire to the specimen surface.
   21. Test the continuity if the soldered joints using a voltmeter:
       1. Turn the voltmeters dial to Ohm setting.
       2. Connect the voltmeter’s leads with the soldered joints to form a closed circuit.
       3. The resistance readout should be presented within 1-2 ohms accuracy from the gage’s nominal ohm specs.
   22. Repeat steps (o)-(u) to the other strain gage located on the bottom surface. Use different color electrical wires.
   23. Paint the fiducial marks for the video extensometer: mark two ink dots through the jig hole on the specimen’s centerline (which you have drawn in step (b)) centered at the gage as much as possible. The dot diameter should be within the range of 2-4 mm, and the gage length should be around 2 inches. Wait for the ink dots to dry out, then cut a strip of black electrical tape and tape it vertically on the specimen in-between the two dots.
   24. Wait another 10 minutes before proceeding with the mechanical tests.
   25. Write down section and group numbers in the specimen and leave it to the TA.
   26. Wash your hands thoroughly to remove any residues of the lead solder.
4. One tiny drop.