EML4552 - Spring 2009 Senior Design



Group 12

Bevel Gear Testbed

Assembly and Calibration Guide

Operations Manual

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Assembly and Calibration Instructions

The following are instructions on the assembly of the bevel gear test bed using each separate component of the design.

Step 1: Lay Baseplate (1) on flat, sturdy surface. Attach Input Support (2) to Baseplate (1) Note: Use four ¹/₄-20 cap screws (A).

Step 2: Attach Input Bearing Block (3) to Input Support (2) Note: Use four ¹/₄-20 cap screws (A). Also the ¹/₂" Input Shaft is connected to the Input Bearing Block (3) with press-fit bearings.



Step 3: Attach Input Motor Mounts (4, 5) to Input Motor (6). Note: Use four 6-32 cap screws (B) on the motor rear and two 10-32 cap screws (C) on the motor front.

Step 4: Attach Input Motor Mounts (4, 5) to Input Motor Mount Footing (7). Note: Use four ¹/₄-20 cap screws (A).

Step 5: Attach the Input Motor Mount Footing (7) to the Input Support (2). Note: Use four ¹/₄-20 cap screws (A).

Step 6: Align Input Motor Assembly (A1) with the ¹/₂" Input Shaft in the Input Bearing Block (3) and connect them. Note: Use a 6-32 set screw (D).



Step 7: Attach Input Gear Tooling (Ω) to $\frac{1}{2}$ " Input Shaft. Note: Use a 6-32 set screw (D).



Step 8: Attach Rotary Table (8) to Baseplate (1). Note: Use two ¹/₄-20 cap screws (A).

Step 9: Assemble the overhang assembly (A2) and attach to the Baseplate (1).

Note: Use ¹/₄-20 cap screws (A) to attach legs to the Baseplate (1) and ¹/₄-20 flat heads (E) to attach the top face to the legs. **Step 10**: Insert T-slots (9) into Rotary Table (8) and attach Steel Adapter Plate (10). Note: Use four 3/8-16 cap screws (F) to connect (9) to (10).

Step 11: Attach Output Bearing Block (11) to Adapter Plate (10).

Note: Use four short head $\frac{1}{4}$ -20 cap screws (G). Also the $\frac{1}{2}$ Output Shaft is connected to the Output Bearing Block (11) with press-fit bearings.

Step 12: Attach Output Motor Mounts (12, 13) to Resistive Motor (14).

Note: Use four 6-32 cap screws (B) on the motor rear and two 10-32 cap screws (C) on the motor front.



Step 13: Attach Output Motor Mounts (12, 13) to Output Motor Mount Footing (15). Note: Use four ¹/₄-20 cap screws (A).

Step 14: Attach the Output Motor Mount Footing (15) to the Adapter Plate (10). Note: Use four ¹/₄-20 cap screws (H).

Step 15: Align Output Motor Assembly (A3) with the ¹/₂" Output Shaft in the Output Bearing Block (11) and connect them. Note: Use a 6-32 set screw (D) to connect

¹/₂" Output Shaft to motor.



Step 16: Attach Output Gear Tooling (ω) to ¹/₂" Output Shaft. Note: Use a 6-32 set screw (D).

Step 17: Connect Edge Finder

(16) to Edge Finder Tooling

(16A)





Step 19: Calibrate the Rotary Table (8) in the input *y*-direction using the Edge Finder (16). Note: Connect the red wire of (16) to the + terminal on the battery and ground the black (-) wire to the table somewhere. Dial the *y*direction of (8) until (16) just barely touches the face of (Ω); the edge finder will illuminate when its tip touches the face of the tooling (Ω). Set the graduation dial on the *y*-direction handle to zero: this is the new reference in the *y*-direction.¹

Step 20: Detach Edge Finder Assembly (16A) from Output Gear Tooling (ω) and insert onto Input Gear Tooling (Ω).

Step 21: Calibrate the Rotary Table (8) in the output *x*direction using the Edge Finder (16).

Note: see note at end of Step 19, replacing y with x.¹

¹ Once the reference point (origin) is obtained, be careful not to lose track of number of rotations of the translational handles, as this is the only basis for alignment.



Step 22: Remove Edge Finder Assembly (A4) from output *x*direction and attach Input Gear (G_i) to Input Gear Tooling (Ω). Note: Use a 6-32 set screw (D).

Step 23: Attach Output Gear (G_o) to Output Gear Tooling (ω). Note: Use a 6-32 set screw (D).

Step 24: Mesh Input and Output Gears ($G_i \& G_o$) using provided mounting distance, based on calibrated origin from Steps 19-21.

Note: once the gears are meshed properly, lock the table down by tightening the black 1/4-20 bolts on the outside of the Rotary Table (8).



Operations Manual

For the following steps, use Figure 1 and Figure 2 on the next page as illustrated references. Figure 1 is the wiring diagram for the controller and Figure 2 is the overall system.

- Step 1: Attach Positive Terminal of Input Motor to Positive Terminal of Channel 1 of Power Supply. Attach Negative Terminal of Input Motor to Negative Terminal of Channel 1 of Power Supply.
- Step 2: When connecting the Controller to the Power Supply, attach the High Voltage (Pin 5, P2) to the Positive Terminal of Channel 2 of the Power Supply. Attach the Power Ground (Pin 4, P2) to the Negative Terminal of Channel 2 of the Power Supply.
 NOTE: Acceptable range is 20-80VDC. Don't hook this up backwards or the drive will overload and be unusable!
- Step 3: When connecting the Controller to the Output Resistive Motor, attach Positive Terminal of Output Motor to Positive Motor Terminal (Pin 2, P2). Attach Negative Terminal of Output Motor to Negative Motor Terminal (Pin 1, P2).
- Step 4: When connecting the Controller to the Potentiometer, connect one of the outside terminals to the +5V OUT (Pin 1, P1). Connect the other outside terminal to the -5V OUT (Pin 3, P1). Connect the middle terminal to +Ref IN (Pin 4, P1).
- Step 5: All components are now connected. Adjust the input voltage (Channel 1 of Power Supply) to set the correct input rotational speed. This relationship is yet to be determined and will be included in the testing addendum. A tachometer will be used to determine the rotational speed.
- Step 6: Adjust the output voltage and output current (Channel 2 of Power Supply) to set the resistive output torque of the Output Motor. Adjust the Potentiometer to output the required current. This relationship is yet to be determined and will be included in the testing addendum.



Figure 1 - Controller Wiring Diagram



Figure 2 - Actual Wiring Setup