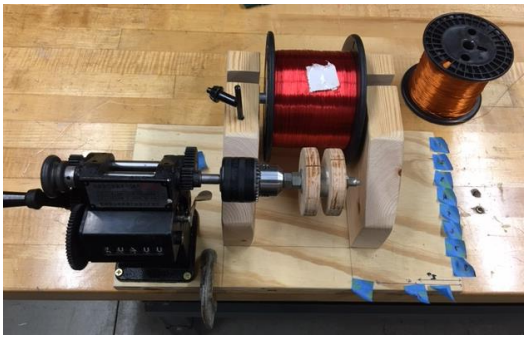
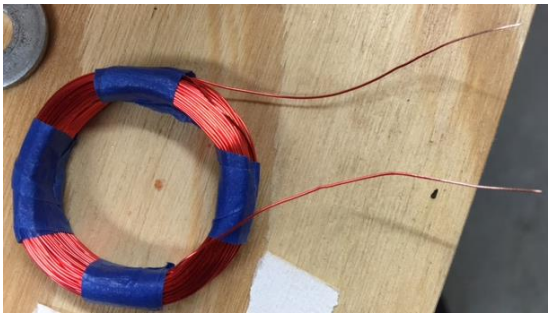
Module-03 Wind Turbine Coil Winding and Measurement

Coils are multi-loops of wire that concentrate the magnet flux from a magnet. Relative motion between the magnetic flux and the coils induce an electric current in the loops of wire. In this module you will wind four 200-turn coils and measure the actual turns, resistance, weight and coil areas. The major goal of this module is to produce four, tightly-wound, 3/8 inch thickness coils. A uniform coil thickness will allow for minimizing the coil-magnet spacing, maximizing the generated voltage. The measured data will be compared to coil-estimate model data.



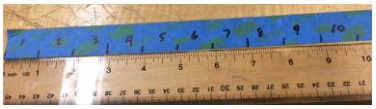
Coil Winding Setup



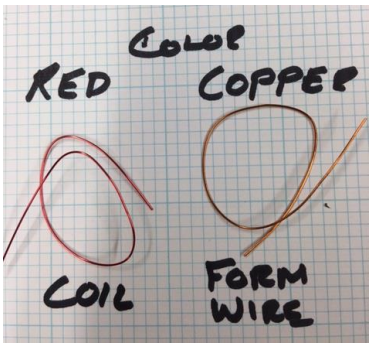
Completed Coil

Procedure

1. To temporarily secure a coil after removing the coil from the winding core, cut four 4-inch copper-colored wires per coil (16 total). These will be used as securing wires
2. Cut ten squares of tape for securing wirers.
3. Insert the four wires in the side-form slots and tape the ends to the form sides.

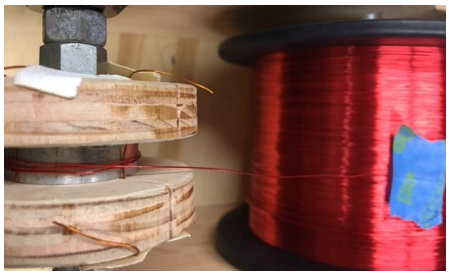


Cut Ten Squares of Tape



Copper Color Wire

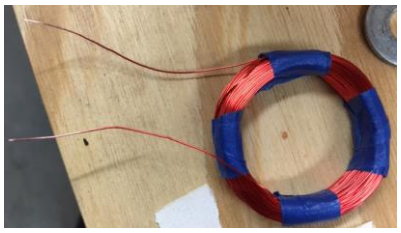
4. Hand wrap three turns around the core while applying tension to the wire spool and advance coil winder to a count of three.

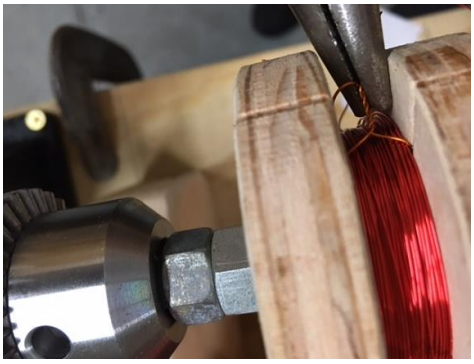


5. Hand wrap three turns around the core while applying tension to the wire spool.

6. Coil Winding
   Turn the coil winder until the counter indicates 200.

7. Remove the coil
   Remove the securing-wires tape and snugly twist them together. This will allow you to remove the coil without it unwinding. Loosen the winding shaft locking nut and side the side-form off the shaft. Carefully slide the coil off the shaft.

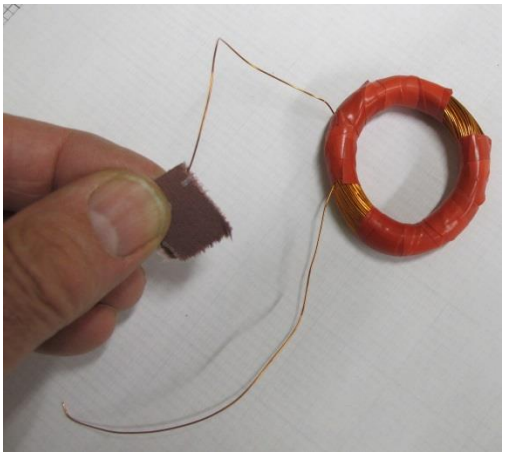




Twist the ends of the coil-holding wires

8. Tape Coil
   Cut four lengths of tape, 2-inches long. Tape the coils producing a uniform coil. Carefully untwist the holding wires that were used to allow sliding the coil off the core. Mark this coil “A” and enter the counted turns in your journal.

9. Make Four Coils
   Repeat the coil winding and taping procedure (steps 1 through 8) producing three more uniform coils. Mark these coils “B”, “C”, “D” and enter the turns data in your journal.



Remove enamel insulation with emery paper.

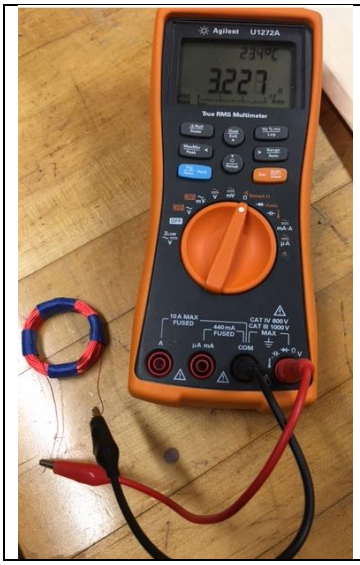
10. Remove Coil Wire Enamel Insulation
    To allow for electrical connection to the coils the enamel insulation must be removed. Using a piece of emery paper sand off ¾ inch of insulation. Only remove the amount of enamel to expose the copper wire. Repeat this process for each end of all coils.

11. Coil Turns Measurement
    Using the Coil-turns tester, slip a coil over the tester shaft and connect the coil end to the clips. Record the number of turns of each coil and enter the data in your journal. Also add the number of turns you counted for each Coil.

12. Measure Coil Resistance
    Using an Ohmmeter measure the resistance of each coil and enter the data in your journal. The coils with the highest number of turns will have the higher resistance.

13. Weigh the Coil
    Weigh, in grams, each coil and record the data in your journal

.



14. Measure the inner and outer diameters and the thickness of the each coil in mm. Use the supplied digital calipers for the measurements. Each team member should perform three the measurements for diameters and thickness on a coil and average the data. In other words, one member measures coil-A then another coil-B and so forth.

15. Enter all data in the supplied Generator Coil Analysis Sheet

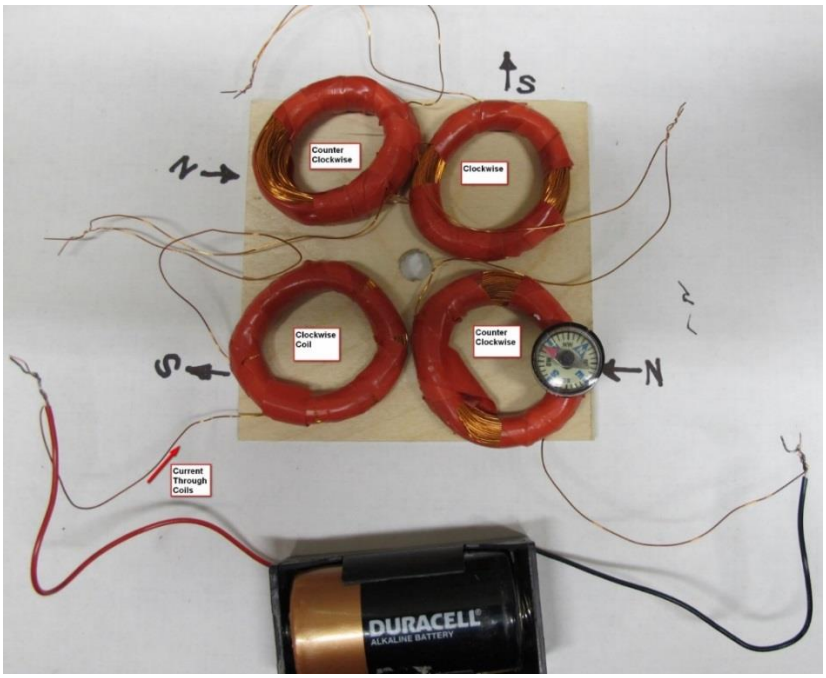
	A	B	C	D	E	F
1	**Generator Coil Analysis**					
2						
3	Coil		Coil Parameter	Back Envelope Estimate	Stacked Model Estimate	Packed Mode Estimat
4	A	T	Coil Turns			
5		x	Wire Diameter (in)			
6		L	Wire Length (ft.)			
7		d	Coil Inner Diameter (mm)			
8		W	Coil Width (mm)			
9		D	Coil Outer Diameter (mm)			
10		m	Coil Weight (g)			
11		R	Coil Resistance (ohms)			
12		A1	Coil Inner Area (m^2)			
13		A2	Coil Outer Area (m^2)			
14		A12	Coil Average Area (m^2)			
15	B	T	Coil Turns			

16. Coil Connections

Connect the coils in series by twisting the bare coils ends together producing a series circuit. Connect the open ends of the circuit to an ohmmeter and measure the total resistance. You should read the sum of the individual coil resistances. If you read a very high resistance one or more of the connections are bad (insulation is still on the wires). Use the ohmmeter to find the bad connection

17. Coil Mounting
    Draw diagonals on the supplied mounting cardboard (4-inch square). At the center drill a 3/8 hole. Position the four coils on the mounting board. Using double-sided tape attach the coils to the mounting board.

18. Alternation Coil Winding Directions
    Connect a 1.5 volt battery to the ends of the coils. Use a small compass to determine the generated magnetic field. Starting with the first coil, approach the coil from the outside and note the direction of the compass needle. Approach the second coil and note compass direction. If it is the same as the first coil either flip the coil over or reverse the twisted wire connection to the first coil. Confirm the compass polarity changes. Repeat the process for the remainder of the coils producing alternating compass directions.



19 Complete the Generator Coil Analysis sheet comparing the measured vs. the estimated values. This must be done for each coil as an Excel spread sheet and enter the appropriate formulas.