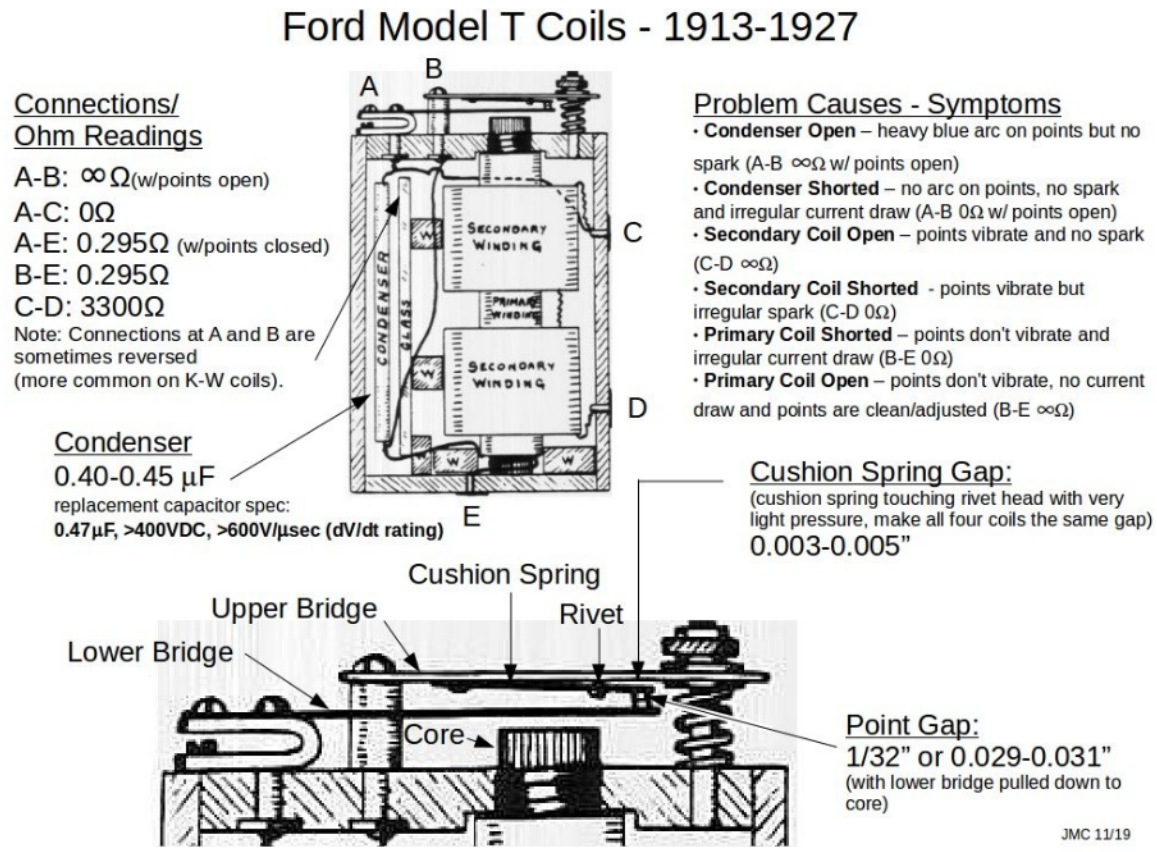
## Basic Electrical Tests

Perform the following texts to diagnose and fix issues detected. Capacitance can be verified by using a multimeter on the high resistance setting and watching reading move slowly then reversing leads to see the same or a capacitance tester. It may be desirable to do Basic Mechanical Adjustments (i.e. remove/replace points) before completing these tests.




**Results:** To record multiple coils use a table in the appendix. (Figure above drawn by John Carter.)

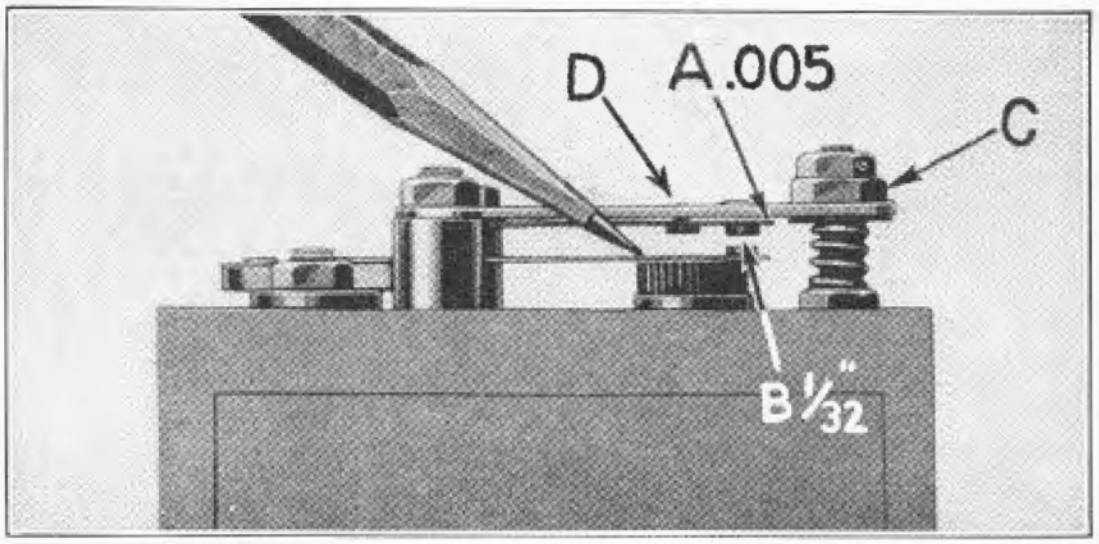
| Test | Desired | Results | Comment |
|---|---|---|---|
| A-B (w/Points open) | ∞Ω | | |
| A-C | 0Ω | | |
| A-E (w/Points closed) | 0.295Ω | | |
| B-E | 0.295Ω | | |
| C-D | 3300Ω (Ford)<br>2100Ω (some KW) | | |
| Point Gap | 1/32" | | |
| Spring Cushion | 0.005 | | |
| Condenser | .47 µF | | |
| Current Draw | 1.3 Amp | | |

**Comments:**

## Basic Mechanical Adjustments

The following are the basic mechanical adjustments needed for a coil. It is a good idea to electrically test coils to verify that you have a rebuildable coil before proceeding.

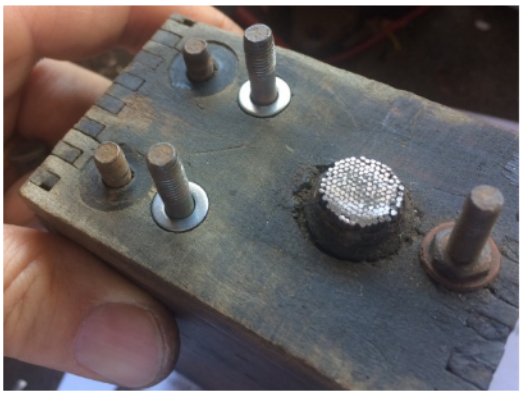
1. **Disassembly**
    - Clean all bolts with a wire brush/wheel to remove rust and dirt.
    - Add favorite oil to threads and allow to set overnight.
    - Gently loosen nuts. Use care to not turn studs as they are electrically connected internally. If nuts are too stubborn they can be carefully ground/cut off.
    - Clean all studs, nuts and determine usable hardware.
    - Before moving forward, this would be a good time to test/replace electrical components including the capacitor. See Basic Electrical Adjustment section.
2. **Cushion Spring Gap**




    - Set Cushion Spring Gap
        - Ford recommended .005" clearance for the full length of the spring.
        - See Ref 13 for more details from Original Ford service manual.
        - Many new points have .020" travel.
        - If cushion spring is not the correct clearance the following two methods can be to remedy the problem.
            1. Gently smash down rivet with hammer.
            2. Using either modified vice grips (see this reference).
        - Be careful, if you go too far you will have no clearance.

3. **Polish Points**
    - Use a wet stone or wet/dry sandpaper to clean/polish points.
    - If deep peaks and valleys use a coarse grit then go down to 1000 grit.

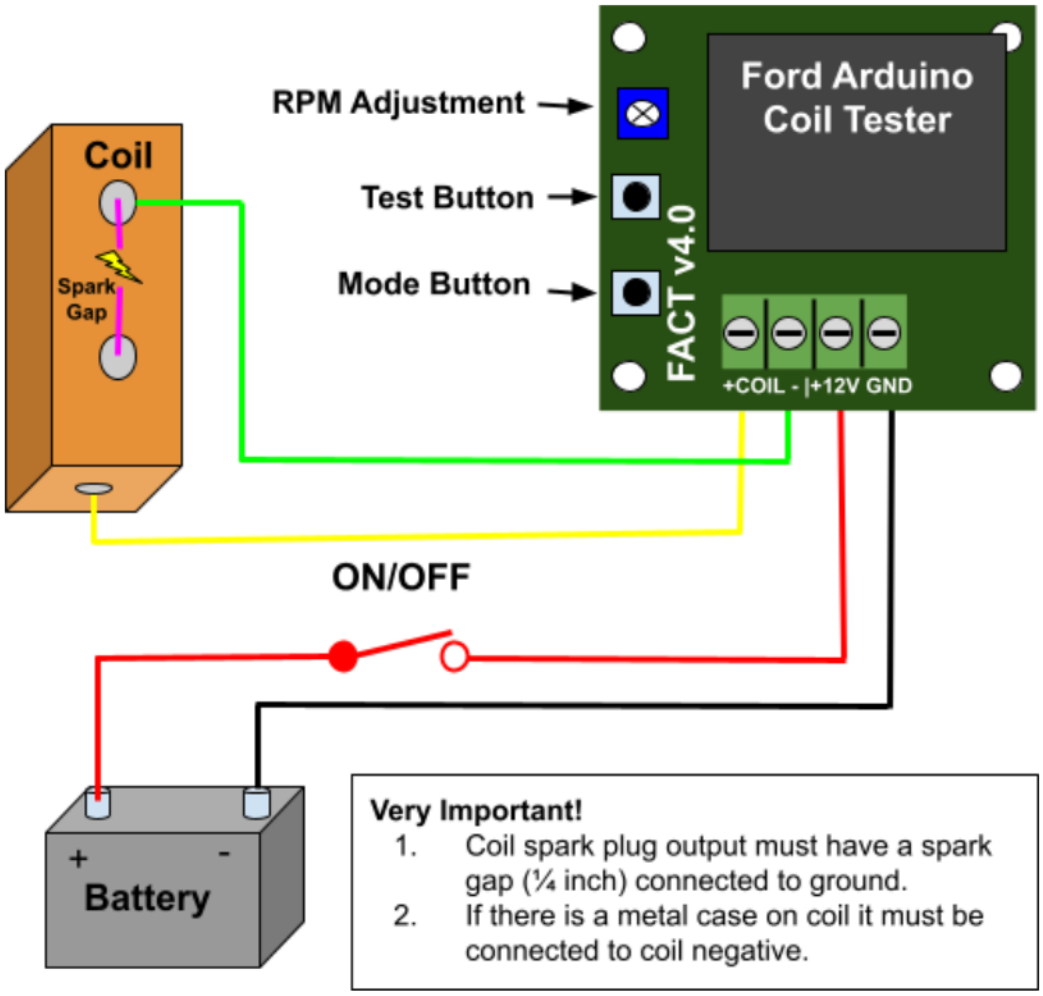
4. **Install Points**
    - Add shims under points if hardware has sunk into wood.
    - Points should come together flat, as seen in image on step 2. If not, shims (washers) can help.



5. **Replace Capacitor**
    - Coils with original capacitors can be found with 0.1 to 5 µF.
    - It is recommended to replace original capacitors.
    - Replacement of capacitors is an involved process that requires caution in carefully removing tar, soldering wires with replacement capacitors and repotting with tar.
    - Because of the work involved it is attractive to have a set of coils refurbished by a skilled rebuilder for a couple hundred dollars, but then that would make most of the recommendations here not relevant.
6. **Set Point Gap**
    - Ford recommended that points be set to 1/32” (.031”) gap when the coil spring is pulled down.
    - This can be done with a feeler gauge or use a small paper clip (of correct diameter).
7. **Set Spring Tension**
    - It is recommended that the current be set to 1.3 A @ 6 Volts by adjusting tension.
    - Tension can be set by gently prying and hammering on the lower bridge.

## Testing with the Ford Arduino Coil Tester (FACT)

Please refer to the following pictorial diagram for connecting the Ford Arduino Coil Tester:




Simply put, the FACT coil tester is an oscilloscope that graphically displays the time to fire and current consumed by the coil. The FACT does this by sending an electronic pulse for 50 ms.

The following are the test modes:

- **Single Fire-** graphs current and displays time-to-fire and maximum current measurements.
- **Live Oscilloscope-** displaying overlapping waveforms and average time-to-fire and maximum current measurement.
- **Bar Graph-** displaying time-to-fire measurements as a bar graph.
- **Multiple Fire-** statistical information on time-to-fire measurements
- **Capacitance-** test coil and continuously displays capacitance and series resistance of capacitor.
- **Capacitance graph test-** displays charging curve for capacitor then displays capacitance and series resistance of capacitor.

## Dynamic Coil Adjustments

To fully test a Model T ignition coil it must be dynamically tested. Originally the Hand Crank Coil Tester (HCCT) was used. In the 1960s oscilloscopes were used in testing mechanical points on distributor testors. In the 1980s, there is evidence that people were using oscilloscopes to tune model T ignition coils. In the last few decades, a few alternatives were made available (i.e. Strobo-Spark, ECCT, and now the Ford Arduino Coil Tester). Ultimately the goal is to create four *matched* coils that produce sparks with similar dwell and spark intensity over a wide range of engine speeds. All of these products have been used successfully. The FACT uses both the visual display of the oscilloscope and time-to-fire concept. Use the following steps to test a Model T coil using the FACT.

1. Connect to a 12 volt power supply. (8-18 VDC okay. A regulated power source is desired for consistent results.)
2. Turn on power to FACT.
3. Place the coil in the tester.
4. Press the **Mode button** on the FACT tester to select one of the following tests.
5. **SINGLE FIRE TEST**
    a. Press the **Test button** for a single fire test.
    b. Examine the waveform:

| | | |
|---|---|---|
|  |  |  |
| **Good** waveform. Nice ramp with clean drop off. | **Double Spark** caused by improper adjustment of cushion spring. | **Bad Capacitor** causes faulty waveform. |

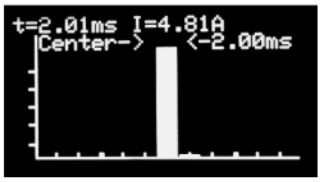
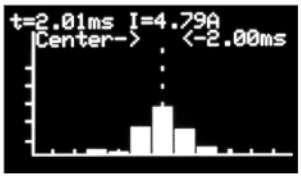
    c. If the waveform is good, adjust the spring tension to get the desired time-to-fire (e.g. 2 ms with 12 VDC source). The goal is to get a set of four coils with the same time-to-fire value.
    d. If there is a double spark, adjust the upper bridge cushion spring.

6. **LIVE O-SCOPE**
    a. Press the **Test button** for the continuous fire oscilloscope test. This will repeat the single fire test and give overlapping waveforms.
    b. Examine waveform:

| | | |
|---|---|---|
|  |  |  |
| **Good waveform** Waveforms overlap with narrow lines and a new waveform is just starting on the far right. | **Double Spark** causes lots of overlapping waveforms after the initial ramp. | **Bad waveform** Lots of inconsistent overlapping waveforms. |

    c. The rpm may be adjusted using the potentiometer for this test.

7. **BAR GRAPH TEST**
    a. Press the **Test button** to display the time-to-fire as a bar graph.
    b. Examine waveform:

| | | |
|---|---|---|
|  |  |  |
| **Ideal**<br>It is desirable to have all the time-to-fire measurements in a single 0.1 ms column. | **Okay**<br>If the coil is a bit erratic some of the measurements will fall in the adjacent columns. | **Bad**<br>Very erratic measurements will lead to data in many different bars |

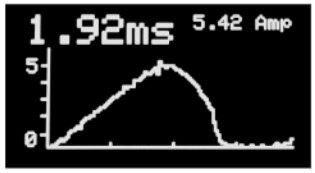
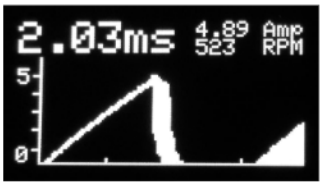
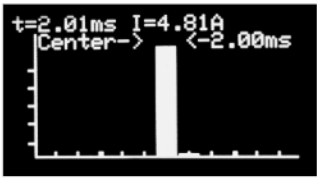
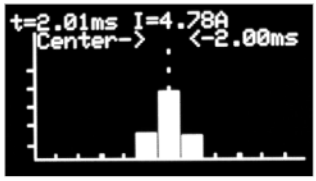
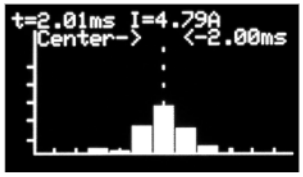
    c. The center position may be adjusted using the potentiometer for this test.

8. **MULTIFIRE TEST**
    a. Press the **Test button** to display the time-to-fire statistical data. This will continuously display and update statistical measurement.
    b. Press the **Test button** a second time to end the test.
    c. The speed (rpm) of this test is controlled by the potentiometer. If the speed was faster/slower than desired, adjust to desired speed in rpm. Most coils the speed doesn't change the outcome of the measurements, so it is suggested to set fully clockwise to measure at full speed.
    d. Examine test results:


    e. Verify statistics are desirable

| Parameter | Description |
|---|---|
| t | Average time to fire in milliseconds. Numbers in the parentheses are the maximum and minimum values. |
| SD | Standard Deviation. The smaller the value the higher the precision, so a small value is desirable. |
| Dwell | Degrees of dwell. Determined by the range between max and min time-to-fire and answer is in degrees of rotation. |
| Max Current | Average of maximum currents measured. |
| RPM | The speed may be adjusted using potentiometer for this test. |
| Misfires | The count of the number of times the current didn't reach a threshold to be considered acceptable. |

# FACT Testing Cheat Sheet

| | | | |
|---|---|---|---|
| **SINGLE FIRE TEST** |  |  |  |
| | **Good** waveform. Nice ramp with clean drop off. | **Double Spark** caused by improper adjustment of cushion spring. | **Bad Capacitor** causes faulty waveform. |
| **LIVE OSCILLOSCOPE** |  |  |  |
| | **Good waveform** Waveforms overlap with narrow lines and a new waveform is just starting on the far right. | **Double Spark** causes lots of overlapping waveforms after the initial ramp. | **Bad waveform**<br>Lots of inconsistent overlapping waveforms. |
| **BAR GRAPH TEST** |  |  |  |
| | **Ideal**<br>It is desirable to have all the time-to-fire measurements in a single 0.1 ms column. | **Okay**<br>If the coil is a bit erratic some of the measurements will fall in the adjacent columns. | **Bad**<br>Very erratic measurements will lead to data in many different bars |
| **MULTIFIRE TEST** |  | t = Average time to fire in milliseconds.<br>SD = Standard Deviation. The smaller the value the higher the precision, so a small value is desirable.<br>Dwell = Degrees of dwell<br>Max Current = Average of maximum currents measured.<br>RPM=The speed may be adjusted using potentiometer. | |
| **CAPACITOR TEST-** Graphical Analysis |  |  |  |
| | **Good** waveform. Note that the waveform traces the ideal waveform. | **Points Closed.** Points must be opened for testing. (Place a piece of paper in points for testing.) | **Bad Capacitor** causes faulty waveform. |
| **CAPACITOR TEST-** Detailed Analysis (Shown after Graphical Analysis.) |  | |  |
| | **Good** capacitor is in the prescribed range. | | **Bad Capacitor** causes faulty waveform. |