How to Build a Tesla Coil

-ENERGYBYTES-
How to Build a Tesla Coil

ENERGYBYTES

TESLA
This book features the suggested methods for creating a Nikola Tesla Fuelless Generator. The author and distributor of the book are not responsible for the actual attempts, the results or any potential injury caused by the attempting to build and run the generator.

Please use extreme caution when attempting any building project. Extreme caution is needed when handling electricity and any generators. Any injures will not be compensated by the author or distributor of this book. No loses will be compensated in any way.
# Table of Contents

Introduction ............................................................................................................................................. 6

Safety Precautions ................................................................................................................................... 7

*Fast safety tips for Tesla coil makers* ................................................................................................... 7

*Issues to be aware of* ........................................................................................................................... 8

Designing Your Tesla Coil ......................................................................................................................... 9

Parts ....................................................................................................................................................... 10

*Power Supply* ................................................................................................................................... 10

PFC Capacitors ..................................................................................................................................... 13

Line Filters ....................................................................................................................................... 13

NST Protection .................................................................................................................................... 14

*The Terry Filter design* ....................................................................................................................... 15

*Spark Gap* ..................................................................................................................................... 16

*Primary Coil* .................................................................................................................................... 21

*Secondary Coil* ................................................................................................................................... 23

*Top Load* ....................................................................................................................................... 25

*Chassis* ............................................................................................................................................ 27

Design Touch-ups .................................................................................................................................. 28

*Calculations* ................................................................................................................................... 28

Construction .......................................................................................................................................... 31

*Materials* ....................................................................................................................................... 31

*Tools* ............................................................................................................................................. 32

*Wiring* ............................................................................................................................................. 32

*Grounding* ....................................................................................................................................... 32
Introduction

This is the place to be if you have ever wanted a guide that takes you through the process of building a Tesla coil. If you have an understanding of electronics, some leisure time and all the equipment, you too can build your very own Tesla coil. Hopefully this guide will provide a simple to follow process and inform you of everything you need to know.

If you want to build a Tesla coil that can create arcs over 4 foot (1.2 meters) from simple materials, this guide is for you. As well as instructions, this guide offers diagrams, material lists and a whole lot more including helpful tips.

The first stage is considering the design process and understanding the materials required to build a Tesla coil. Following this, the guide looks at taking the materials and fashioning your own Tesla coil. Finally, the tricky final parts are considered and hopefully your Tesla coil will be up and running.

Although this guide is up to date at the time of publication, there is every chance that new technologies have superseded some of the ideas you may find here.

Thanks for looking and the best of luck in creating a Tesla coil.
Safety Precautions

Safety precautions must always be taken on a task like this because if used or built incorrectly, a Tesla coil can be fatal. Be sure not to build a Tesla coil without knowing the proper procedures for working with high voltage electricity. This is not school and the process can be unsafe if you do not know what you are doing. There are high voltages involved, currents, magnetic fields, chemicals, exposed wires and many other dangers.

Always work in a well ventilated room and try to use proper safety equipment. Also remember you should never look at the spark gaps and if possible, have someone working alongside you. Another good tip is to never work when you are tired or under the influence of alcohol or any other drugs, and be sure to know where the fire exits and extinguishers are.

Fast safety tips for Tesla coil makers

When the power is on, do not adjust the Tesla coil.

- Do not touch the high voltage capacitors immediately after tuning the power off. They hold charge so be sure to leave it a while. Only attempt to adjust the primary circuit after a reasonable amount of time.
- Be sure to ground all metal cases. This will be discussed later in the guide.
- The corona discharge can be dangerous so be sure to leave plenty of room from it when you are working. Also make sure that you do not make contact with any other additional metal object for fear of secondary contact.
- CAUTION: As the low voltage primary circuit can be very dangerous be sure that the primary circuit is insulated and that people are unable to make contact with the A.C. line voltage.
- Using a key for access will prevent unauthorized use of the Tesla coil.
- Be sure that all precautions involving wires, fuses and circuit breakers have been met. Your home circuit panel is not equipped to deal with the high voltage created by the Tesla coil.
- If children, pets, water or other forms of shock hazard are present, do not use the Tesla coil.
- Never use glue or tape when constructing the circuits. Please ensure that no wires are exposed. Creating a Tesla coil is not a normal situation so do not take these things for granted. The level of voltage that is generated can be lethal so please ensure all safety precautions are taken.

NEVER TOUCH THE ELECTRICAL ARCS. They have the ability to kill or seriously harm you. Professionals and experts are able to control these arcs but they have had intensive training. Again, **DO NOT TOUCH THE ARCS.**
**Issues to be aware of**

- The Neon Sign Transmitter (NST) is used as a primary power source. This unit provides many thousand volts and, apart from a quiet hum, there is little indication it is working. Take precautions when using the NST. And do not make an assumption it is turned off, always examine it first.

- Tesla coils are able to create intense RF interference. To lower the chance of this happening, ground all currents.
Designing Your Tesla Coil

Before you design the coil, a few decisions have to be made regarding the parameters. Always consider them when making the coil and in thinking about the parts you need, this will be of benefit when designing.

- What level of output voltage do you require from NST
- Are you looking to use a rotary or static spark gap?
- What diameter of wire will you use for the primary coil and what width do you want for the spacing between the coil turns?
- What diameter of wire will you use for the secondary coil and what height do you want the secondary coil to have and what sizes of gauge will you require for this secondary coil?
- What level of top load do you require?
The exact construction of your Tesla coil will be dependent on many factors including parts, materials and preferences. You will need the following components:

**Power Supply**

Some examples of power supplies:
Avoid using:

The supply should be considered; you want a transformer that can be used to provide charge to the initial capacitor. The secondary winding is therefore able to heighten the power in the primary winding. When building the Tesla coil, a transformer of at least 5kV is required, if not, the spark may not be able to fire correctly.

You can choose between the following transformers

- NSTs – Have become the most popular choice of power supplies. GFCI or GFI models are expensive but come with the ability to shut down the NST if any unusual spikes are detected. Of course, as the Tesla coil produces unusual spikes, this may see your NST shutting down regularly. Utilizing an older version of the NST makes sense and ensures it has just the primary and secondary windings and a core made of metal.
- Oil-Burner Ignit Transformers (OBIT)
- Microwave Oven Transformers (MOT)
- Bombarding transformer – These weigh more than 150lbs and are hard to find.
- Pole Pig. This choice is only for the experiences Tesla maker as they are very heavy and are unable to limit current levels.

The NSTs remains the best options and these can be found in many places. Recycling centers, and even salvage yards may provide a way to buy the NST. Safety is a huge factor in buying an NST as it contains the ability to limit current internally and using metal plates ensure the current can be limited when shortage has occurred to the output.
When testing an NST, wire it up and look for arcs appearing between the two terminals. The lower voltage end of the NST should go through a filter and then be connected up at the mains of a building or house. The primary terminal should have the PFC cap wired across it. You should see that common output levels of the NST are 9kV or 12kV, or sometimes 15kV. It is also not uncommon to see 30mA or 60mA in use.

The internal potting material may be a reason that the NST fails. The potting is a tough substance similar to tar. In order to replace the potting, the top of the case has to be removed and the NST needs to be heated. This will melt the potting material but will also unleash toxic material. Be sure to follow all safety procedures and then replace the potting with transformer oil.

If you require an additional current to be added to a Tesla coil, you can wire additional NSTs in parallel.

Do not attempt to wire NSTs in series as this additional voltage will lead to a shorting of any windings. Also, NSTs are able to be placed in parallel as they require separate output currents.

1. Calculate the phase for the NST output. Connect the terminals of each NST to each other. If an arc forms, they are not in phase.
2. If terminals are said to be currently in phase, record them and then record the LVITs – these need to be recorded because using an input terminal can alter the outputs.
3. Place a 1 kOhm resistor in between the in phase output terminals.
4. Operate the NSTs and then turn the power off and determine if the resistor feels warm.
5. Turn the NST power off before making contact with a resistor. If the resistor feels warm, this could be an indication of excess current flowing into the NST. If this occurs, it is not safe to use the NSTs in a parallel formation.
**PFC Capacitors**

(PFC) capacitors can be utilized to realign the AC’s power factor any time they are connected up to the NSTs. If an NST is running, this factor will tail off because of the high inductance which can lead to phase shifts of current and voltage. This can lead to the NST turning off. The cap is able to align both phases which can ensure there is a leveling off in the capacitance and in the inductance.

If the cap is not as big as what is recommended, it is possible to wire PFC caps in parallel.

There are run style capacitors and start style; make sure you only use run types. Using a start type can cause overheating and explosions. Be sure to wire the caps across the lower voltage input of an NST.

PFC caps can be obtained in salvage yards as they are commonly found in washing machines, air conditioners and refrigerators. It should be possible to buy PFC caps online

**Line Filters**

These filters are connected back into the home or wiring of the building and can prevent sparks from occurring.
It is common to find they contain a capacitor which will move higher frequencies down into the ground and the majority of these have inductors that are able to reduce spikes of larger frequency.

Wire this filter in a series alongside the main power source and as far away from the coil as you can. If the wiring is too close, some induced voltages may be able to jump the filter and this can cause a surge. It is up to you to choose between wiring the line filter from the wiring to output or the opposite way. All that matters is that it is wired correctly.

It is possible to buy filters online or by recovering them from equipment. You can construct your own but it is far simpler and cheaper to buy, just as long as you make sure you have a filter that is safe for the coil.

**NST Protection**

The secondary coil wire is extremely thin and this means it is under pressure from any primary circuit high voltage spikes.

Introducing a low filter should help protect the NST from spikes with the Terry fritz created filter, the Terry filter being deemed worthy of use.
**The Terry Filter design**

This design has an RC low pass with contains numerous PFC caps wired in line to move high frequency spikes to ground. Introducing a spark gap should allow for these high voltage spikes to pass safely to the ground and the gap should be wide enough to prevent shortage when connected to the NST output. Every cap contains a resistance bleeder resistor and these should not come into contact with the case of the capacitor as this can cause arcing to take place. These bleeder resistors should be soldered in parallel with every capacitor. This should see the high level of resistance allow a slow discharge ensure that electrical charges are not able to build.

Do not use metal caps, use polypropylene film capacitors.

Here are some finished NST filters that use the Terry Fritz design:
Spark Gap

This is used as a switch that temporarily connects the primary coil and the primary capacitor. After the gap has been shorted, the cap discharges into the coil.

These spark gaps are available in rotary or static designs. A static gap is created if the gap electrodes are stationary and a rotary gap is created when the electrodes rotate.

The most basic of static gap design contains 2 bolts, wires, and drawer knobs to behave as electrodes.
The gap in between the two electrodes is required to be set at a particular width. The best gap will occur at the point where the primary cap hits its peak voltage.

There is the Richard Quark (RQ) and this utilizes a number of copper based tubes to break this gap into smaller gaps. This provides a better level of performance than one of the common static gaps:
“Sync” designs utilize a synchronous motor which redirects the electrodes from the gap. Sync gaps designs take the form of either a disk or propeller. Using this disk style design means the electrodes are affixed to a disk which is connected to the shaft. Using this propeller design behaves in a similar style but has more the look of a propeller of an airplane.
Propeller design:

With the disk design, be sure not to utilize anything smaller than a 5” disk. This is especially true when using high RPM motors. This should make a swirling ionized gas cloud in the gap. Motors with a lower sync will have difficulties in turning the propeller or disk and if this occurs, be sure to use a lighter propeller gap.

The gap should be around 120 times in each minute when it used on a supply of 60Hz. It is found that a spark gap should fire both the negative and positive peaks when using a 60Hz supply. It is common for speeds of 3600 RPM or possible 1200 RPM to be reached for 60 Hz input frequencies. If you are looking to achieve 120 BPS, it will take a higher number of electrodes.

You should be able to find motors on turntables, computers and even stores that sell old military goods. It is possible to buy new motors on the Internet too, Oriental Motor and Hurst being leading suppliers.

**Warning:** In some cases, electrodes will be thrown out of the gap with high velocity. Rotary gaps should always be contained in a box or with walls to prevent material coming loose.
Primary Coil

It is important to know a primary coil combines with the cap in order to make the tank circuit. In addition, this primary coil also plays a role in transferring power from one cap to another.
Primary coils are considered as either being be conical or they can be helical. However, using either of these is likely to increase the peak of the primary coil to the top load, which makes the chances of an arc hitting the primary coil higher. If arcs begin running up your secondary coil, there is a need to place the primary and secondary coils further apart.
There should be a strike ring on the primary coil 2 inches above the outer turn. This ring should prevent arcs coming from the top load hitting the primary coil. An arc strike that reaches the primary coil will generate enough of a spike to destroy the primary caps and even the NST. The ring should never be closed and one of the ends should be attached to the secondary earth ground. Shorter coils are unable to produce arcs that can reach the primary coil and there is no need for these to have a strike ring.

When you are making the primary coil, it makes sense to determine the coil size, the base size and the number of turns that are required in the coil.

**Secondary Coil**

The secondary coil and the top load combine to create an additional tank circuit. The secondary circuit also plays a role in transferring power from one cap to another.
The power output will determine the size of the secondary coil. This means an average Tesla coil, said to be about 1kW requires a 4-6” diameter secondary coil. Coils of a smaller size can have a 3-4” diameter and the larger coils are able to have a 6” diameter. The height of the coil should be around 4-5 times the diameter of the coil. It is best to leave extra inches when cutting the PVC pipe as this should allow for space to wind the wire and ensure arcs are not able to hit the second coil.

It can take time to wind the coil and it may be easier to mount a spool of magnetic wire. It is best to wear protective gloves to prevent the wire cutting your skin or causing calluses on your fingers. Make sure the PVC pipe is dry and clean before winding. Be sure to not leave any space in between the windings and always be sure to leave additional wire at the end. After this, it is best to apply a coat of varnish and any additional wire on the end should be wrapped in a coil and moved out of the way of the coating process.
The top load has a role as the capacitor in the secondary circuit.

The top load is made of anything that is smooth in shape and can be completely covered in foil made of aluminum. A method that is common for construction is to place aluminum dryer duct all the way around an aluminum pie pan.
It is extremely common to see a donut or a toroid as the shape for a top load. When the coil is on, the charge will begin to build around the top loads surface. The strength of this field should be distributed evenly across the surface. This should create smaller but equally distributed arcs. When the ball is flattened into the toroid, the radius becomes the stronger part, which is where arcs form. This sees the arcs shape outward.

The size and frequency of the arcs is impacted upon by the top load size and level of power applied by the top load. A top load that is small will produce frequent and small arcs. A big top load will make less but bigger arcs. A toroid that is too big will be unable to make any arcs and a breakout point, such as a tack, would need to be applied. This will have the ability of disrupting the field and the field would start from here rather than focusing on the complete surface area.

It is common for the toroid to be the same size in diameter as the secondary coil. So this means that the complete diameter of the toroid is required to be roughly 4 times the diameter of the aforementioned ring, which means there is a need for this dryer duct of 4 inch diameter to be placed in an 8 inch pie to guarantee that there is a complete diameter of 16 inches.

The toroid shape should meet the upper section of the secondary coil. To do this, start by drilling a hole in the middle of a PVC-style end cap and then consider using a nylon bolt. Be sure to also drill a hole into the middle of the pan and then place it onto the bolt. **It is important to not use metal as arcs will shoot.**

Toroid capacitances are notoriously hard to calculate, which means a lot of attention needs to be paid when working out calculations.
Chassis

Every component making up the Tesla coil has to be housed in a chassis. This will make transportation of the coil simpler and should allow it to be contained better.

Many chassis designs are made from plastic platforms or sometimes, wood platforms, and these platforms have the ability to house a large number of parts. It is wise to make the chassis from non-conducive materials.
Design Touch-ups

It is now time to complete your designs whilst paying attention to these parameters:

- NST (power supply)
- Style of primary-spark gap (static or rotary)
- Primary coil wire – what size of diameter and size of wire spacing
- Secondary-coil – what size of diameter and size of height
- Secondary-coil magnet – what number of wire AWG
- Dimensions of top load

Once your decisions are complete, it is time to build your Tesla coil.

Calculations

The calculations should be followed

\[ \pi = 3.1415926535897932384626433832795 \]

\[ \text{NST VA} = \text{NST Output Current} \times \text{NST Output Voltage} \]

\[ \text{NST Impedance} = \frac{\text{NST Output Voltage}}{\text{NST Output Current}} \]

\[ \text{NST Watts} = ((0.6 / \text{NST VA}^{0.5}) + 1) \times \text{NST VA} \]

\[ \text{PFC Capacitance} = \frac{(\text{NST VA} / (2 \times \pi \times \text{NST Input Frequency} \times (\text{NST Input Voltage}^2))) \times 1000000}{\text{Primary Resonate Capacitance} = (1 / (2 \times \pi \times \text{NST Impedance} \times \text{NST Input Frequency})) \times 1000} \]

\[ \text{Primary LTR Static Capacitance} = \text{Primary Resonate Capacitance} \times 1.5 \]

\[ \text{Primary LTR Sync Capacitance} = 0.83 \times (\text{NST Output Current} / (2 \times \text{NST Input Frequency} / \text{NST Output Voltage}) \times 1000; \]

\[ \text{Secondary Coil Turns} = (1 / (\text{Magnet Wire Diameter} + 0.000001)) \times \text{Secondary Wire Winding Height} \times 0.97 \]

\[ \text{Secondary Capacitance} = (0.29 \times \text{Secondary Wire Winding Height}) + (0.41 \times (\text{Secondary Form Diameter} / 2)) + (1.94 \times \sqrt{((\text{Secondary Form Diameter} / 2)^3) / \text{Secondary Wire Winding Height}}) \]

\[ \text{Secondary Height Width Ratio} = \frac{\text{Secondary Wire Winding Height}}{\text{Secondary Form Diameter}} \]
Secondary Coil Wire Length = \((\text{Secondary Coil Turns} \times (\text{Secondary Form Diameter} \times \pi)) / 12\)

Secondary Coil Wire Weight = \(\pi \times ((\text{Secondary Bare Wire Diameter} / 2)^2) \times \text{Secondary Coil Wire Length} \times 3.86\)

Secondary Inductance = \(((\text{Secondary Coil Turns}^2) \times ((\text{Secondary Form Diameter} / 2)^2)) / \left((9 \times (\text{Secondary Form Diameter} / 2)) + (10 \times \text{Secondary Wire Winding Height})\right)) \times 0.001\) * Secondary Inductance Adjust

Sphere Capacitance = 2.83915 \times (\text{Sphere Diameter} / 2)

**For toroids of a small size, Ring Diameter < 3" or Ring Diameter > 20"

Take the average of three toroid capacitance calculations.

- Toroid Capacitance 1 = ((1 + (0.2781 - \text{Ring Diameter} / (\text{Overall Diameter}))) \times 2.8 \times \sqrt{\pi \times ((\text{Overall Diameter} \times \text{Ring Diameter})) / 4})
- Toroid Capacitance 2 = (1.28 - \text{Ring Diameter} / \text{Overall Diameter}) \times \sqrt{2 \times \pi \times \text{Ring Diameter} \times (\text{Overall Diameter} - \text{Ring Diameter})}
- Toroid Capacitance 3 = 4.43927641749 \times ((0.5 \times (\text{Ring Diameter} \times (\text{Overall Diameter} - \text{Ring Diameter}))) \times 0.5)
- Toroid Capacitance = (((\text{Toroid Capacitance 1} + \text{Toroid Capacitance 2} + \text{Toroid Capacitance 3}) / 3)

**For a Ring Diameter ranging between 3" and 6"

- Toroid Capacitance Lower = 1.6079 \times \text{Overall Diameter} \times 0.8419
- Toroid Capacitance Upper = 2.0233 \times \text{Overall Diameter} \times 0.8085
- Toroid Capacitance = (((\text{Ring Diameter} - 3) / 3) \times (\text{Toroid Capacitance Upper} - \text{Toroid Capacitance Lower})) + \text{Toroid Capacitance Lower}

**For a Ring Diameter ranging between 6" and 12"

- Toroid Capacitance Lower = 2.0233 \times \text{Overall Diameter} \times 0.8085
- Toroid Capacitance Upper = 2.0586 \times \text{Overall Diameter} \times 0.8365
- Toroid Capacitance = (((\text{Ring Diameter} - 6) / 6) \times (\text{Toroid Capacitance Upper} - \text{Toroid Capacitance Lower})) + \text{Toroid Capacitance Lower}

**For a Ring Diameter ranging between 12" and 20"

- Toroid Capacitance Lower = 2.0586 \times \text{Overall Diameter} \times 0.8365
- Toroid Capacitance Upper = 2.2628 \times \text{Overall Diameter} \times 0.8339
- Toroid Capacitance = (((\text{Ring Diameter} - 12) / 12) \times (\text{Toroid Capacitance Upper} - \text{Toroid Capacitance Lower})) + \text{Toroid Capacitance Lower}

Top Load Capacitance = (\text{Toroid Capacitance} + \text{Sphere Capacitance}) \times \text{Top Load Adjust}

Total Secondary Capacitance = \text{Secondary Capacitance} + \text{Top Load Capacitance}
Secondary Resonate Frequency = \( \frac{1}{(2 \times \pi \times \sqrt{\text{Secondary Inductance} \times 0.001} \times (\text{Total Secondary Capacitance} \times 0.0000001)}) \)

Needed Primary Inductance = \( \frac{1}{(4 \times \pi^2 \times (\text{Secondary Resonate Frequency} \times 1000)^2 \times (\text{Primary Capacitance} \times 0.0000000000001))} \)

Primary Coil Hypotenuse = (Primary Coil Wire Diameter + Primary Coil Wire Spacing) \times \text{Turns}

Primary Coil Adjacent Side = Primary Coil Hypotenuse \times \cos(\text{toRadians}(\text{Primary Coil Incline Angle}))

Primary Coil Diameter = (Primary Coil Adjacent Side \times 2) + Primary Coil Hole Diameter

Primary Coil Height = Primary Coil Wire Diameter + Primary Coil Adjacent Side \times \tan(\text{toRadians}(\text{Primary Coil Incline Angle}))

Primary Coil Wire Length = Primary Coil Diameter \times \pi / 12

Primary Coil Average Winding Radius = (Primary Coil Hole Diameter / 2) + (Primary Coil Hypotenuse / 2)

Primary Coil Inductance Flat = (Primary Coil Average Winding Radius ^2 \times \text{Turns} ^2) / ((8 \times \text{Primary Coil Average Winding Radius}) + (11 \times \text{Primary Coil Hypotenuse}))

Primary Coil Winding Radius = (Primary Coil Hole Diameter / 2) + (Primary Coil Wire Diameter / 2)

Primary Coil Inductance Helix = ((\text{Turns} \times \text{Primary Coil Winding Radius} ^2) / ((9 \times \text{Primary Coil Winding Radius}) + (10 \times \text{Primary Coil Height}))

Angle Percent = 0.01 \times (\text{Primary Coil Incline Angle} \times 1.1111111111)

Angle Percent Inverted = (100 - (\text{Angle Percent} \times 100)) \times 0.01

Primary Coil Inductance = (\text{Primary Coil Inductance Helix} \times \text{Angle Percent}) + (\text{Primary Coil Inductance Flat} \times \text{Angle Percent Inverted})

Convert Inches To Cm = Inches \times 2.54

Convert cm To Inches = cm \times 0.393700787

Convert Feet To Meters = Feet \times 0.3048

Convert Meters To Feet = Meters \times 3.2808399
No two Tesla coils are the same and your design will impact on what you need. However, the following list will contain the majority of items you require:

**Materials**

- Chassis, frame, cabinet or enclosure
- Power cord to plug into the wall outlet or mains wiring
- Power switch
- Variac
- Line filter
- Power
- Supply
- PFC caps
- NST filter
- Spark gap materials
- Primary capacitors, bleeder resistors, pref board e
- Primary coil materials
- PVC pipe, magnet wire
- Top load materials
- Ground rod
- High voltage wire to ensure the components are connected or low-resistance wire for spark plugs.
- Plywood or Plexiglas and pref board.
- Assortment of nuts, various bolts and washers, etc
Tools

These should be considered as an outline of the tools you need but this is not a definitive list.

- Soldering iron and solder
- Multimeter
- Drill
- Saw for cutting plywood
- Hacksaw for cutting wood and PVC
- Wire cutters, pliers
- Measuring tape, calipers, ruler
- Screwdrivers, sockets, wrenches
- Epoxy or glue

Wiring

Keep all wiring as short as you can. Do not use loops which will cause inductance. Avoid running wires in parallel or in close distance. Wires should be GTO. Any low voltage insulation wires should be routed away from conductive material. Ensure all connections are clean as a dirty or bad connection can reduce efficiency and has the potential to cause a fire.

Grounding

It is essential to have two separate grounds for the Tesla coil. The first should be the house and this should be the green wire contained in electrical outlets.

The next ground should be the RF ground and this is to be connected to a metal grounding rod that has been driven into the ground. This rod should be placed close to the Tesla coil and a good distance away from the house. The rod should be placed 7-9’ into the ground if possible.

There is no 100% solution to Tesla coil grounding so be sure to understand the principles of grounding and to do everything you can to ensure the grounding is sufficient for your needs.
Running Your Tesla Coil

You will be keen to try your Tesla coil but carry out a few checks first to prevent any unforeseen accidents or incidents from occurring.

**Adjust Gaps**

*Spark gaps.* Ensure the widths have been set for best performance. The correct width depends on the size of electrode, shape and surface finish. Factors like air pressure and humidity can also affect this factor.

Remove the NST output from the coil and then connect each spark gap straight to the NST output. This should remove all voltage spikes and should enable you to open the gaps without destroying all the MMCs.

Be sure to clean spark gaps and make adjustments if required to reduce the threat of corrosion. A low resistance (few ohms), high power resistor placed in series with the safety gap will reduce any stress on the caps.

*For spark gaps.* Create a main spark gap width of around 0.5” or 13mm. Switch on the Tesla coil and make sure that the gap is not shorting. Reduce the main spark gap width to around 0.1” or 2mm at a time until shorting begins.

*Rotary gap.* The gap firing is required to appear in line when the voltage reaches its positive or negative peak. It is also possible to rotate the disk or propeller that is connected to the motor.

**Tuning**

Tuning creates longer arcs. The inductance of the primary coil should be the easiest part to make adjustments tot. Tap the primary at the recommended frequency of turns and run the coil whilst examining for the length of the arc. If the arcs have increased in length, you should deem this a moving in the right direction. As you reach the optimum tap point, decrease the size of turns.

You should now be ready to operate the Tesla coil. In order to stop voltage spikes getting into the house wiring, be sure that all electronic devices are unplugged. White goods can be left plugged in. Have fun but stay safe.
Things To Try With Your New Tesla Coil

Having completed your Tesla coil, you will want to know what you can do with it.

A fluorescent tube located close to the top load should light up with no need of a power source.

Arcs that strike a grounded target, such as a metal pole, should be longer, brighter and notably thicker.

Troubleshooting

If you experience problems when running the Tesla coil, these tips may help.

Inspect the wiring and connections.

If problems persist, ensure the power supply is plugged in, and check to see if a fuse or circuit breaker has blown. If not, examine the NST. Disconnect the outputs of the NST filter and then reconnect these outputs to a spark gap which carries a short gap distance. If arc appears from the NST filter outputs you should consider the power supply as working.

If you have a variac, it should be removed from the circuit.

If spark gaps are causing problems, adjust them in the manner described in the guide.

If arcs are not occurring, put a fluorescent tube close to the top load. If the fluorescent tube lights up faintly when the Tesla coil is running this means the top load is generating an electromagnetic field, but the field is too weak to allow arcs to break out.

If the top load is too large, reduce the size of the top load. This will force you to retune the coil but should ensure sparks can hit the coil.

Ensure the MMC caps are intact.
Frequently Asked Questions

If I switch from a 9kV NST to a 15kV NST will I be forced to rebuild my Tesla coil

No. Parts will need to be readjusted—spark gaps, MMC capacitance, retuning.

Do the primary and secondary coils need to be wound in the same direction?

No.

Why should I build a Tesla coil?

Building Tesla coils is a fantastic way to learn about electricity, electrical components, assembling / wiring components and safety. And creating lightning is totally cool!

What is the cost of building a Tesla coil?

It can vary from one dollar to several hundred dollars, depending on where you get parts.

Where can I get parts for a Tesla coil?

Many places including local home improvement stores, salvage yards, recycling centers, or by using the internet.
Further Reading

http://www.pupman.com/
If you are still stuck after reading the FAQs, try this website

http://teslastuff.com/
Fantastic for finding those hard to find parts.

http://octopart.com/
If you are after electronic parts, this is the search engine to trust.

http://en.wikipedia.org/wiki/Tesla_coil
Great source of info on Tesla coils.

http://hub.webring.org/hub/teslaring
A collection of Tesla coil websites.

http://www.classictesla.com/
Searching for a good online JAVA design program? Here it is!

http://www.falstad.com/circuit/
Electronic circuit Simulator JAVA applet. Tesla coil circuit is located in: Circuits -> Misc Devices -> Spark Gap

http://www.stevehv.4hv.org/
Great source of information about Tesla coils.

http://www.dmoz.org/Science/Technology/Electronics/High_Voltage/Generators/Tesla_Coils/
Tesla coil website directory

http://www.teslacoildesign.com/