# PRIMARY AND SECONDARY COILS

**PSC001**

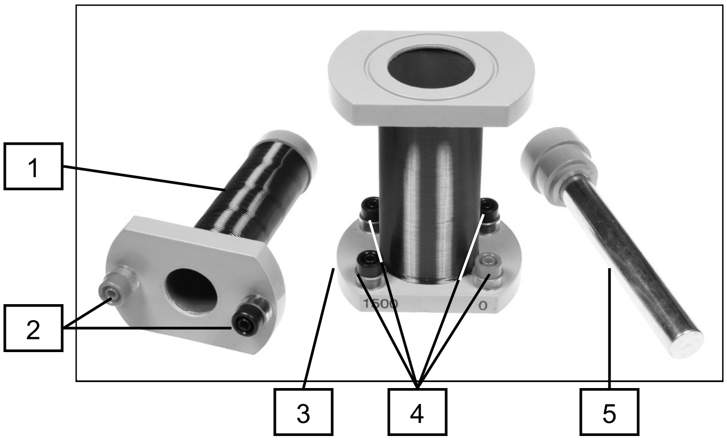


*Figure 1*


*Figure 2*

## DESCRIPTION

The PSC001 Primary and Secondary Coils consist of a small diameter primary coil (1*, Figure 1*) with 175 turns of 18 AWG insulated copper wire and a pair of shielded sockets (2), a larger diameter secondary coil (3) with 1500 turns of 26 AWG wire and four shielded sockets (4) to allow 500, 1000, or 1500 turns to be selected, and a plated iron core (5) with a molded handle.

The core and primary coil fit inside the secondary coil (*Figure 2*). Experiments to demonstrate the principles of electromagnetic induction using a d.c. or a.c. power source can be easily carried out. Self-induction with a single coil and mutual induction with both coils can be shown either with or without the iron core in place. The secondary coil may also be used separately as a solenoid.

The molded plastic formers provide robust support for the coils and ensure that the apparatus can withstand laboratory use.

**SPECIFICATIONS**

| | |
|---|---|
| Primary Coil: | 175 turns of 18 AWG insulated copper wire<br>Diameter 34 mm, length 100 mm<br>Resistance 0.43Ω, Self-inductance approx. 3 mH |
| Secondary Coil: | Three windings of 26AWG insulated copper wire<br>500 turns, 1000 turns, and 1500 turns<br>Diameter 52 mm, length 102 mm<br>Resistances (500/1000/1500 turns) 11.5Ω/23.3Ω/35.7Ω<br>Self-inductances (approx.) 490 mH/1.97 H/4.43 H |
| Removable Core: | Diameter 19 mm, length 165 mm (including handle)<br>Plated iron with molded plastic handle. |
| Weight: | 907 g (2.0 lb) |

**BACKGROUND**

From his experiments with a conductor moving in the field of a magnet, Michael Faraday discovered that a voltage is produced in the conductor, and that the size of the voltage is proportional to the speed of the movement. This phenomenon is called electromagnetic induction. Further experimentation generalized this early discovery, and what is now known as Faraday's Law can be stated as *the induced voltage is proportional to the rate of change of magnetic flux in a conductor*. It is not specified how this rate of change of flux is achieved. This is commonly expressed mathematically as:

$$E = -d\Phi/dt$$

where E is the induced electromotive force (not necessarily the same as the observable voltage because of the electrical resistance of the conductor) and Φ is the momentary magnetic flux threading the conductor. Note the minus sign, indicating that the e.m.f. opposes the change in flux (this is also known as Lenz's Law.)

In the Primary & Secondary Coils apparatus, the magnetic flux is generated by a current flowing in one of the coils, and when the current changes this results in induced voltages in the coil carrying the current, and in a secondary coil surrounding it, if it is present.

The induced voltages are also influenced by the material inside the coils. Ferromagnetic materials such as iron greatly increase the induction effects in comparison with air.

The Primary & Secondary Coils apparatus allows experiments to be performed to demonstrate these phenomena in various ways:

- The induced voltage in a single coil (*self induction*) when a d.c. current is switched on or off
  - as a function of the number of turns of the coil
  - as a function of the material inside the coil—air or iron
- The induced voltage in a secondary coil (*mutual induction*) when a d.c. current is switched on or off in the primary coil
  - as a function of the number of turns of the secondary coil
  - as a function of the material inside the coils—air or iron
- The induced voltage in a secondary coil when an a.c. current is passed through the primary coil
  - as a function of the number of turns of the secondary coil
  - as a function of the material inside the coils—air or iron

The secondary coil may also be used alone as a solenoid for investigating the production of a magnetic field by a current.