

## **demo1**

Category: Physics-equipments

### **Description**

demo desc1

### **Features**

demo fet1

### **Specifications**

demo spec1



## Digital Multimeter

Category: Physics-equipments

### Description

- **Measurement Unit:** Measures potential difference in **Volts (V)** and Current in **Ampere (A)**
- **Internal Resistance:** Typically very high, approaching millions of ohms (ideally infinite ohms).
- **Measuring Range:** Varies by model, commonly 0 to 20V DC and 0 to 750V AC.
- **Display Type:** **Digital LCD screen** with multi digit display.
- **Connection:** Must be connected in **Parallel** across the component being tested.

### Features

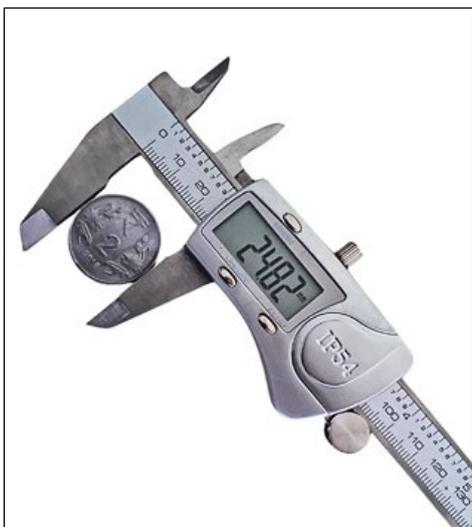
- **High Digital Accuracy:** Provides superior accuracy and resolution, often reading to several decimal places, clearly displayed on a large **LCD screen** to minimize reading errors.
- **High Internal Resistance:** Engineered with **extremely high internal resistance** to ensure that when connected in parallel, it draws negligible current and does not affect the voltage measurement.
- **Versatile AC DC Modes:** Capable of measuring both **Direct**

**Current (DC) voltage** (from batteries or power supplies) and **Alternating Current (AC) voltage** (from mains or generators).

- **Auto Ranging Functionality:** Many models feature **automatic ranging**, which intelligently selects the correct measurement scale, simplifying use and protecting the device from overload.
- **Data Functions:** Often includes features such as **data hold** to freeze the last reading, and **min max recording** to capture transient voltage changes.

### **Specifications**

- **Measurement Unit:** Measures potential difference in **Volts (V)**.
- **Internal Resistance:** Typically very high, approaching millions of ohms (ideally infinite ohms).
- **Measuring Range:** Varies by model, commonly 0 to 20V DC and 0 to 750V AC.
- **Display Type:** **Digital LCD screen** with multi digit display.
- **Connection:** Must be connected in **Parallel** across the component being tested.



## Digital Vernier Caliper

Category: Physics-equipments

### Description

The **Digital Vernier Caliper** is an advanced, high-precision measuring instrument essential for any modern physics, engineering, or manufacturing laboratory. It performs the same function as a traditional mechanical caliper, accurately measuring **outer diameter, inner diameter, and depth**, but uses an **electronic linear encoder** and a digital display to provide the reading. This eliminates the need for manual interpretation of the Vernier scale, significantly reducing measurement error and increasing speed. The digital readout displays the measurement directly in a numerical format, often to three decimal places. It is a vital tool for quickly acquiring and recording highly precise dimensional measurements for experiments involving size, volume, or tolerance checking.

### Features

- **High Digital Accuracy:** Provides superior accuracy and resolution, typically to **0.001 mm** or **0.0005 inch**, displayed clearly on a large **LCD screen**, minimizing human reading error.
- **Multiple Measurement Modes:** Features **three sets of jaws and a depth rod** to measure external, internal, and depth dimensions, ensuring versatility across different applications.
- **Unit Conversion:** Includes a simple button function to instantly **switch between metric (mm) and imperial (inch) units** without needing to recalibrate the instrument.

**Zero and Hold Function:** Offers a **zero setting function** at any point along the scale for differential measurements and a **data hold function** to lock the measurement reading on the screen.

- **Durable Construction:** Made from hardened **stainless steel** or composite materials for long lasting precision, stability, and resistance to corrosion in laboratory environments.

### **Specifications**

- **Measuring Range:** Available in common ranges such as **0 to 150 mm** (0 to 6 inches) or **0 to 300 mm** (0 to 12 inches).
- **Accuracy Resolution:** High precision, typically **0.01 mm** or **0.0005 inch** reading capability.
- **Material:** Hardened Stainless Steel or high quality tool steel.
- **Display:** Large, clear **LCD screen** for numerical readout.
- **Power:** Requires a small battery, typically a 1.5V button cell, for operation.



## Thermometer

Category: Physics-equipments

### Description

A **Thermometer** is a fundamental instrument used across all scientific disciplines to accurately measure **temperature**, which is a measure of the hotness or coldness of a substance.

Laboratory thermometers typically rely on the principle of **thermal expansion**, using a liquid (such as colored alcohol or mercury) sealed within a glass tube. As the temperature rises, the liquid expands up a precisely calibrated scale. Modern laboratories also utilize **Digital Thermometers** which use electronic sensors (thermistors or thermocouples) to provide fast, highly precise numerical readouts. Thermometers are essential for conducting virtually every experiment in **thermodynamics, chemistry, and biology**, ensuring accurate data collection for processes like heating, cooling, phase changes, and reaction kinetics.

### Features

- **Accurate Temperature Reading:** Provides a precise and reliable reading of temperature, essential for accurate data recording in scientific experiments.
- **Wide Measurement Range:** Available in various forms to cover a broad spectrum of temperatures, from deep freezing points to high boiling points, suitable for all laboratory work.
- **Types Available:** Offered in classic **liquid in glass** format (using alcohol or mercury) and modern **digital formats** (using electronic sensors) for specific accuracy and speed requirements.

**Clear Calibration:** Features a **clear and durable scale** marked in standard units, typically **degrees Celsius (C)**, but also available in Fahrenheit (F) or Kelvin (K).

- **Chemical Resistance:** Constructed with a **durable glass casing** for chemical resistance, allowing for immersion in most common laboratory liquids and solutions.

### **Specifications**

- **Measuring Unit:** Measures temperature in **degrees Celsius (C)**.
- **Operating Principle:** Liquid in glass (thermal expansion) or Digital (electronic sensor).
- **Range:** Varies by model, commonly 0 C to 100 C for general use, or wider ranges like -10 C to 150 C for specialized work.
- **Resolution:** Typically marked with a resolution of 1.0 degree C or 0.1 degree C.
- **Application:** Used for general temperature monitoring, measuring specific heat, determining boiling and freezing points, and monitoring reaction kinetics.



## Mechanical Stopwatch

Category: Physics-equipments

### Description

A **Mechanical Stopwatch** is a robust and traditional timing instrument used to measure the duration of an event with high precision. Unlike digital timers, it operates purely on mechanical principles, using a calibrated spring and gear train mechanism. It is typically activated and stopped by pressing a single crown or button, which also resets the hands to zero. This type of stopwatch is essential in many physics and sports laboratories for experiments involving time-dependent phenomena, such as measuring the **period of a pendulum**, the **time of flight** for projectiles, or the **rate of a chemical reaction**. It is valued for its audible clicking mechanism and its independence from battery power, providing a reliable, hands-on tool for teaching basic measurement and uncertainty in timing.

### Features

- **Reliable Mechanical Action:** Operates using a sturdy **spring and gear assembly**, offering reliable timing independent of any electrical power source (batteries or mains).
- **Precise Time Measurement:** Capable of measuring time with a high degree of precision, typically reading to **0.1 second** or **0.2 second** intervals on the analog dial.
- **One Button Operation:** Simple and intuitive operation, often using a single **crown or plunger** to start, stop, and reset the mechanism, minimizing confusion during experiments.

**Analog Display:** Features a **clear analog dial** with two hands (one for seconds, one for minutes) for easy, visual reading of the elapsed time.

- **Durable Casing:** Housed in a **robust metal or durable plastic casing** to withstand the repeated use and handling common in busy educational laboratories.

### **Specifications**

- **Apparatus Type:** Spring-driven, non-electronic timing instrument.
- **Display:** Analog dial with primary (seconds) and secondary (minutes) hands.
- **Accuracy (Least Count):** Typically 0.1 s (one tenth of a second) or 0.2 s per division.
- **Timing Range:** Usually capable of measuring events up to 30 minutes or 60 minutes duration.
- **Application:** Used for measuring time periods of oscillations, motion experiments, and reaction timing in educational physics and chemistry.



## Glass Prism

Category: Physics-equipments

### Description

A Glass Prism is a transparent optical element with flat polished surfaces that refract light. It is one of the most fundamental tools in the study of optics and the properties of light. The classic triangular prism with two triangular bases and three rectangular faces is designed to perform two primary functions: **dispersion** and **deviation**. When white light enters a prism the difference in refractive index for different wavelengths causes the light to separate into its constituent colors (the spectrum) a process known as dispersion. Furthermore the prism deviates (bends) the light path making it ideal for experiments measuring the angle of deviation and the refractive index of the glass material itself. Prisms are indispensable for demonstrating the nature of visible light and the laws of refraction.

### Features

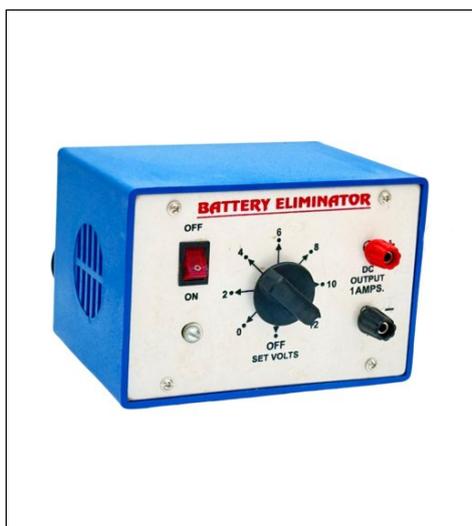
- Dispersion of Light: Provides a classic and clear demonstration of dispersion splitting incident white light into the visible spectrum of colors (rainbow effect).
- Refraction Study: Used to accurately measure the angle of minimum deviation and apply Snell's Law to determine the refractive index of the prism material.
- High Optical Clarity: Manufactured from high quality optical glass (such as crown or flint glass) with precisely polished faces for minimum light scattering and distortion.

Deviation Control: The prism geometry allows for predictable bending (deviation) of the light path essential for steering light in more complex optical setups.

- **Versatile Shapes:** Available in various geometric shapes most commonly the equilateral triangle but also right angle trapezoidal and other forms for specific applications like total internal reflection.

### **Specifications**

- **Apparatus Type:** Solid, transparent optical element.
- **Material:** High quality **Optical Glass** (Crown glass is common).
- **Shape:** Typically an **Equilateral Prism** with a base angle of 60 degrees.
- **Surfaces:** Three flat, highly polished, and precisely angled surfaces.
- **Application:** Used for light dispersion, measuring refractive index, angle of deviation, and demonstrating total internal reflection.



## Battery Eliminator

Category: Physics-equipments

### Description

- **Apparatus Type:** Transformer based power supply unit.
- **Input Power:** Standard AC mains voltage, typically 110V or 220V AC.
- **Output Type:** Regulated **Direct Current (DC)**.
- **Output Voltage Range:** Adjustable steps typically from 1.5V DC up to 12V DC.
- **Output Current:** Available in various current ratings, commonly 1A, 2A, or 5 A maximum output.

### Features

- **Regulated DC Output:** Provides a **smooth, filtered DC voltage** with minimal ripple, essential for accurate and repeatable electrical and electronic circuit experiments.
- **Adjustable Voltage:** Features a **rotary selector switch** or fine adjustment knob to easily select a precise output voltage level, typically in steps (e.g., 1.5V, 3V, 4.5V, 6V, 9V, 12 V).
- **Cost Effective:** Acts as a **permanent power source**, eliminating the recurrent cost, inconvenience, and environmental waste associated with using disposable batteries.
- **Safety Protection:** Includes safety features such as **current limiting, thermal cutoff, and short circuit protection** to prevent damage to the

unit and the experimental circuit.

- **Robust Terminals:** Equipped with clearly marked, secure **output terminals** (often banana plug jacks or binding posts) for easy and safe connection to laboratory circuits.

### **Specifications**

- **Apparatus Type:** Transformer based power supply unit.
- **Input Power:** Standard AC mains voltage, typically 110V or 220V AC.
- **Output Type:** Regulated **Direct Current (DC)**.
- **Output Voltage Range:** Adjustable steps typically from 1.5V DC up to 12V DC.
- **Output Current:** Available in various current ratings, commonly 1A, 2A, or 5 A maximum output.



## Simple Pendulum

Category: Physics-equipments

### Description

The **Simple Pendulum** is a fundamental piece of apparatus in mechanics labs, used to demonstrate and investigate the principles of **simple harmonic motion (SHM)**, **oscillation**, and the determination of the **acceleration due to gravity (g)**. It consists of a small, dense mass (the bob) suspended from a fixed point by a long, light string or thread. When displaced and released, the pendulum swings in a periodic motion. For small angular displacements, the **period of oscillation** depends only on the **length of the string** and the acceleration due to gravity, and is independent of the mass of the bob. This apparatus provides a classic, repeatable, and easily observable experiment crucial for teaching time, length, and the basic laws of motion.

### Features

- **Simple Harmonic Motion:** Provides a clear, low friction system for studying and verifying the conditions and properties of **simple harmonic motion** for small angle oscillations.
- **Gravity Determination:** Allows students to perform the classic experiment to accurately calculate the **local value of the acceleration due to gravity (g)** by measuring the period and length.
- **Variable Length:** The setup is designed to easily adjust the **effective length of the pendulum**, enabling the collection of data to verify the relationship between period and length.

**Minimizes Air Resistance:** The use of a small, dense metal **bob** and a light string helps to **minimize air resistance**, ensuring that the system acts as close to the theoretical ideal as possible.

- **Durable Components:** Typically includes a **metal bob** with a small hook and durable thread, intended for suspension from a fixed clamp or pendulum stand

### **Specifications**

- **Apparatus Type:** System for demonstrating and measuring simple harmonic motion.
- **Components:** Includes a dense **metal bob** (sphere or cylinder) and a length of light thread or string.
- **Bob Material:** Usually Brass, Steel, or Lead for high density and minimal air drag.
- **Required Setup:** Needs a **rigid suspension clamp** or stand and a **stopwatch** for measuring the period of oscillation.
- **Application:** Used for studying the period of oscillation, calculating acceleration due to gravity, and demonstrating the laws of pendulums.



## Newton Force Meter

Category: Physics-equipments

### Description

The **Newton Force Meter**, commonly known as a **Spring Scale** or **Dynamometer**, is a fundamental instrument used in physics laboratories to measure **force** or **weight**. It operates based on **Hooke's Law**, which states that the force applied to a spring is directly proportional to the distance it is stretched or compressed. The meter consists of a calibrated spring enclosed in a casing with a scale marked in **Newtons (N)**, the standard unit of force, and often simultaneously in grams (g) for mass measurement. By hanging an object from the hook or pushing against the sensor, the meter provides a **direct, visible reading** of the applied force. It is an indispensable tool for experiments involving gravity, friction, tension, and the vector nature of forces.

### Features

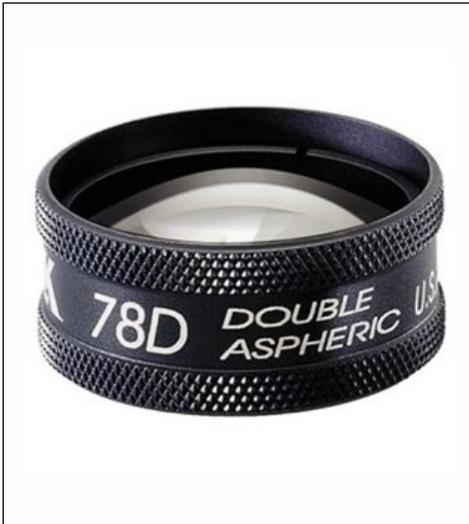
- **Direct Force Measurement:** Provides a fast, direct, and **accurate measurement of force** in the metric unit of **Newtons**, crucial for mechanics experiments.
- **Hooke's Law Demonstration:** Visually demonstrates the principle of **elasticity and Hooke's Law**, showing the linear relationship between applied force and spring extension.
- **Dual Scale Reading:** Typically features a **dual scale** calibrated in both **Newtons (N)** for force and **grams or kilograms (g/kg)** for mass or weight measurement.

**Zero Adjustment:** Includes a simple mechanism at the top for **zeroing the meter** before use, ensuring accurate readings by compensating for the weight of the hook or any minor spring fatigue.

- **Durable Construction:** Built with a **robust metal spring** and a clear plastic or metal casing to withstand repeated stretching and provide a long operational lifespan in student labs.

### **Specifications**

- **Measuring Unit:** Calibrated to measure force in **Newtons (N)**.
- **Operating Principle:** Based on the principle of **Hookes Law** and spring extension.
- **Measuring Range:** Available in various ranges, commonly 0 to 1 N, 0 to 5 N, 0 to 10 N, up to 0 to 50 N or more.
- **Construction:** Metal spring housed in a plastic or metal body with top ring and bottom hook.
- **Application:** Used for measuring tension, friction, weight, and resolving forces into vectors



## Aspheric Lens

Category: Physics-equipments

### Description

An **Aspheric Lens** is an optical lens whose surface profiles are not sections of a sphere or cylinder, but are instead mathematically defined to achieve superior optical performance compared to traditional spherical lenses. While a spherical lens has a constant radius of curvature, an aspheric lens has a radius of curvature that **continuously changes** from the center to the edge. This design modification is engineered specifically to eliminate **spherical aberration**, a common optical defect where light rays passing through the edges of a spherical lens focus at a different point than those passing through the center. By removing this defect, a single aspheric lens can often replace a complex multi element lens system, resulting in **lighter, smaller, and sharper** optical instruments like high end cameras, microscopes, and laser systems.

### Features

- **Spherical Aberration Correction:** The key feature is the ability to **completely eliminate spherical aberration**, leading to a much sharper and clearer image across the entire field of view.
- **System Simplification:** Often allows for the replacement of two or more conventional spherical lenses with a **single aspheric lens**, significantly reducing the weight and complexity of an optical assembly.
- **High Numerical Aperture:** Can be designed with a **higher numerical aperture** than spherical lenses, allowing them to

gather more light and perform better in low light conditions.

- **Precision Manufacturing:** Requires highly precise manufacturing techniques such as diamond turning or precision molding to achieve the exact **non spherical surface profile** necessary for optimum performance.
- **Wide Application Range:** Essential in modern optical technology, including compact digital cameras, CD and DVD players, ophthalmic devices, and high power laser focusing systems.

### Specifications

- **Lens Type:** Non spherical surface profile lens.
- **Material:** Available in optical glass, polymer, or infrared transmitting materials.
- **Optical Property:** Designed primarily for **aberration correction** (specifically spherical aberration).
- **Diameter Range:** Varies widely, from small millimeter sizes for sensors up to large diameters for laboratory telescopes.
- **Coating:** Often includes an **Anti Reflection (AR) coating** to maximize light transmission and minimize surface reflections.



## Ammeter

Category: Physics-equipments

### Description

The **Ammeter** is a fundamental electrical measuring instrument used to determine the **electric current** flowing through a point in an electrical circuit. It measures current in units of **Amperes (A)**. To correctly measure the current flowing *through* a component, an ammeter must always be connected in **series** with that component. It is designed to have very **low internal resistance** so that it does not significantly alter the current it is trying to measure. Laboratory ammeters are available in two primary forms: **Analog Ammeters**, which use a moving pointer over a calibrated scale, and **Digital Ammeters**, which display the current reading directly as a numerical value, offering higher precision and faster reading

### Features

- **Direct Current Measurement:** Provides an accurate and direct reading of the **magnitude of electric current** (electron flow) in any part of a circuit.
- **Series Connection Design:** Engineered with **extremely low internal resistance** to ensure that when connected in series, it minimally affects the total resistance and current flow of the circuit.
- **Versatile Types:** Available in both **Analog (pointer type)** for basic demonstration and **Digital (LCD display)** for higher precision and ease of reading.

**Wide Range Capability:** Offered in various models to measure different current levels, ranging from microamperes ( $\mu\text{A}$ ) and milliamperes ( $\text{mA}$ ) for electronics to full Amperes for power circuits.

- **Robust Terminals:** Equipped with clearly marked **positive and negative terminals** for safe and correct connection into the electrical circuit path.

### Specifications

- **Measurement Unit:** Measures current in **Amperes (A)**.
- **Internal Resistance:** Typically very low, approaching zero ohms (ideally 0 ohm).
- **Measuring Range:** Available in ranges such as 0 to 1 A, 0 to 5 A, or 0 to 500 mA DC or AC.
- **Display Type:** Available as **Analog (moving coil)** or **Digital (LCD display)**.
- **Connection:** Must be connected in **Series** with the circuit component under test



## Calorimeter

Category: Physics-equipments

### Description

A **Calorimeter** is a fundamental piece of laboratory apparatus designed specifically to measure the quantity of **heat energy** absorbed or released during a physical change or chemical reaction. It typically consists of a simple, insulated vessel that holds a measured amount of water or other liquid. The vessel is equipped with a thermometer and a stirrer. By measuring the initial and final temperatures of the liquid, and knowing the specific heat capacity of the liquid and the vessel, the amount of heat transfer ( $Q$ ) can be calculated using the formula  $Q = mc \Delta T$ . This apparatus is crucial for experiments in **thermodynamics and thermochemistry**, allowing students to determine quantities such as specific heat capacity, latent heat, and heats of reaction while minimizing unwanted heat exchange with the external environment.

### Features

- **Heat Isolation:** Designed with **insulating features** (often an air space or thick walls) to minimize heat loss or gain, creating near adiabatic conditions for accurate measurement.
- **Accurate Temperature Monitoring:** Includes a tightly fitted lid with a port for a **thermometer or temperature sensor** to monitor the temperature change ( $\Delta T$ ) of the contained liquid precisely.
- **Uniform Temperature:** Equipped with a **manual or motorized stirrer** to ensure that the entire mass of liquid is at a uniform

temperature, preventing localized hot or cold spots.

- **Durable Construction:** The vessel is typically made of materials with known thermal properties, such as **polished aluminum or copper**, providing excellent durability and consistent performance.
- **Educational Standard:** It is an **indispensable tool** for introductory physics and chemistry laboratories to demonstrate and calculate fundamental concepts of **specific heat and calorimetry**.

### Specifications

- **Apparatus Type:** Insulated vessel for heat transfer measurement.
- **Vessel Material:** Often **Polished Copper or Aluminum** for high thermal conductivity.
- **Accessories:** Includes a tight fitting lid, insulated outer jacket, stirrer, and thermometer access hole.
- **Application:** Used for determining specific heat capacity, latent heat, and heat of fusion or reaction.



## (HYGRADE) Spectrum Discharge Tube

Category: Vacuum-Apparatus-Specialization

### Description

1. **Tube Type:** Low pressure, sealed glass gas discharge tube.
2. **Typical Length:** 20 cm to 30 cm overall length.
3. **Required Operating Voltage:** Requires a **High Voltage Power Supply** typically in the range of 2000 V to 5000 V AC or DC for illumination.
4. **Fittings:** Standardized electrodes for connection via insulated wires.
5. **Available Gases:** Hydrogen H, Helium He, Neon Ne, Argon Ar, Mercury Hg, etc.

### Features

1. **Distinct Emission:** Generates a **bright, clear, and distinct light source** essential for high resolution spectral analysis using a spectrometer or spectroscope.
2. **Fundamental Educational Tool:** Essential apparatus for practical lessons and demonstrations related to atomic theory, Bohrs model, and the concept of light energy corresponding to specific electron energy transitions.

**Sealed Purity:** Manufactured with **sealed glass construction** and high purity internal gas, ensuring long term performance consistency and spectral reliability without contamination.

4. **Standard Compatibility:** Designed for **quick and safe connection** to standard laboratory high voltage power supplies, ensuring easy integration into existing lab setups.
5. **Variety of Elements:** Available in a range of gases, including Hydrogen, Helium, Neon, Mercury, and Argon, to demonstrate the diverse spectra across the periodic table.

### **Specifications**

1. **Tube Type:** Low pressure, sealed glass gas discharge tube.
2. **Typical Length:** 20 cm to 30 cm overall length.
3. **Required Operating Voltage:** Requires a **High Voltage Power Supply** typically in the range of 2000 V to 5000 V AC or DC for illumination.
4. **Fittings:** Standardized electrodes for connection via insulated wires.
5. **Available Gases:** Hydrogen H, Helium He, Neon Ne, Argon Ar, Mercury Hg, etc.



## Diffraction Grating

Category: Lab-Supply

### Description

A **Diffraction Grating** is a precision optical component consisting of a large number of equidistant, parallel lines ruled onto a flat, transparent, or reflective surface. It is the fundamental component of all **spectrometers and monochromators**, replacing the prism for highly accurate wavelength analysis. When light passes through (transmission grating) or reflects off (reflection grating) the grating, it is diffracted into a pattern of spectral orders. This effect separates polychromatic light into its constituent wavelengths much more effectively and with higher resolution than a prism. The grating's ability to precisely separate light based on wavelength makes it an indispensable tool for measuring the **wavelengths of light**, analyzing atomic spectra, and performing complex optical measurements in physics and chemistry labs.

### Features

- **High Resolution Spectral Separation:** Provides superior angular dispersion compared to prisms, enabling the **high resolution separation** and precise analysis of closely spaced spectral lines.
- **Wavelength Determination:** The grating spacing (number of lines per unit length) is accurately known, allowing students to **calculate the exact wavelength** of light using the diffraction grating equation.
- **Multiple Orders:** Produces **multiple bright spectral images**

(diffraction orders) on either side of the central image, providing more data points for measurement and analysis.

- **Durable Construction:** Typically protected by a glass or polymer substrate, offering **durability and resistance** to environmental factors when handled properly in the lab.
- **Versatile Use:** Available in **transmission type** (used directly in the light path) and sometimes **reflection type**, suitable for different spectrometer and experimental setups.

### **Specifications**

- **Apparatus Type:** Precision optical component for light dispersion and analysis.
- **Ruling Density:** Varies by application, commonly available with **500 lines per mm** or **1000 lines per mm** (or more) spacing.
- **Substrate:** High quality clear **Glass** or durable optical grade **Polymer**.
- **Application:** Used for measuring wavelengths, calculating grating spacing, and analyzing spectral composition in optics and atomic physics experiments.
- **Size:** Available in various sizes, typically small, square plates of \$25 ext{ mm}\$ to \$50 ext{ mm}\$ dimensions.



## Vernier Caliper

Category: Lab-Supply

### Description

The **Vernier Caliper** is an essential precision measuring instrument used in physics, engineering, and manufacturing to measure linear dimensions with high accuracy. It operates on the principle of the **Vernier scale**, where a smaller, movable secondary scale slides alongside a main scale to increase reading precision far beyond a standard ruler. This tool is designed to accurately measure three things: **outer diameter** of objects, **inner diameter** of holes, and the **depth** of recesses. The two main types available are the **Mechanical Vernier Caliper**, which requires reading the coincident line on the Vernier scale, and the **Dial Caliper**, which displays the fractional reading directly on a circular dial for faster, less error-prone measurements.

### Features

- **High Precision Measurement:** Provides readings with a high degree of precision, typically up to **002 mm** or **001 inch**, making it ideal for detailed laboratory experiments.
- **Multiple Measurement Modes:** Features **three sets of jaws and a depth rod** to accurately measure external dimensions, internal dimensions, and the depth of holes or recesses.
- **Durable Construction:** Built from hardened **stainless steel** or chrome plated metal for excellent durability, resistance to corrosion, and long term calibration stability.

**Zero Adjustment:** Includes a mechanism for **zeroing the scale** before use, ensuring the accuracy of all measurements by compensating for any minor wear or jaw misalignment.

- **Versatile Types:** Available in traditional **Mechanical Vernier** models and **Dial** models offering faster, direct fractional readings via a clock face.

### Specifications

- **Measuring Range:** Available in common ranges such as **0 to 150 mm** (0 to 6 inches) or **0 to 300 mm** (0 to 12 inches).
- **Accuracy Least Count:** High precision, typically 002 mm (mechanical) or 001 mm (dial) reading capability.
- **Material:** Hardened Stainless Steel or high quality tool steel.
- **Reading Format:** Available with **Metric** (millimeter) and **Imperial** (inch) scales, or dual scale models.
- **Application:** Used for length, external diameter, internal diameter, and depth measurements in physics and engineering labs.



## Lab Plasticware

Category: Lab-Supply

### Description

This category encompasses a range of essential, multipurpose laboratory vessels and tools molded from durable, chemical resistant plastics, most commonly **polypropylene (PP)** or **polymethylpentene (PMP/TPX)**. Unlike glassware, plasticware offers **superior resistance to breakage**, making it safer and more economical, particularly in student laboratories. Key items include **Beakers** for mixing and heating (up to temperature limits), **Funnels** for transferring liquids and solids, and **Measuring Cylinders** for preparing and dispensing approximate volumes of liquids. These products are lightweight, easy to clean, and feature excellent chemical compatibility with most acids, bases, and common organic solvents, enhancing general lab efficiency.

### Features

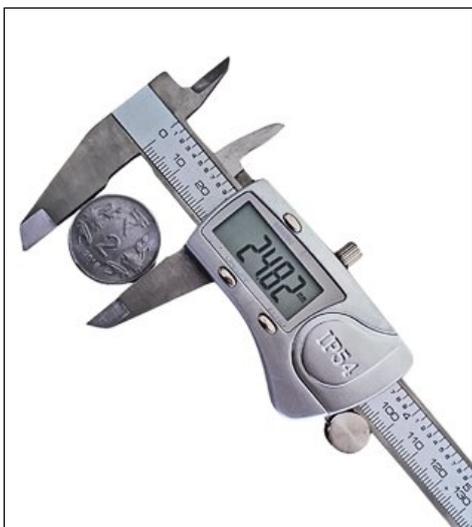
- **High Breakage Resistance:** Provides significantly **greater safety and durability** compared to traditional glass labware, minimizing replacement costs and hazards from shattering.
- **Excellent Chemical Resistance:** Manufactured from high quality polypropylene or other polymers that resist corrosion from a **wide range of laboratory chemicals**, including strong acids and alkalis.
- **Clear Graduation:** Items like Beakers and Measuring Cylinders feature **clear, easy to read, molded or printed graduations** for quick and reliable volume approximation.

**Temperature Tolerance:** Polypropylene items can be autoclaved and safely handle liquids at **higher temperatures** than standard household plastics, expanding their utility in various experiments.

- **Lightweight and Ergonomic:** The light material makes these items **easy to handle, pour, and store**, reducing user fatigue and simplifying general laboratory tasks.

### **Specifications**

- **Material:** High quality, chemically inert plastics, typically **Polypropylene (PP)** or **PMP (TPX)**.
- **Included Items:** Beakers (various sizes), Measuring Cylinders (various capacities), and Funnels (various diameters).
- **Capacity Range:** Available in common laboratory sizes, from **10ml** measuring cylinders up to **2,000ml** beakers.
- **Temperature Rating:** Suitable for continuous use up to temperatures typically around **120 degrees C** (Polypropylene).
- **Application:** General mixing, transferring, storing, and approximate volume measurement in educational and chemical labs.



## Vernier Caliper

Category: Heat-Energy-Conversion-Apparatus

### Description

The **Vernier Caliper** is an essential precision measuring instrument used in physics, engineering, and machining to measure linear dimensions, including **outer diameter, inner diameter, and depth**, with high accuracy. It operates on the principle of the Vernier scale, where a smaller secondary scale slides alongside a main scale to increase reading precision. The two main types are the **Mechanical Vernier Caliper**, which requires reading the coincident line on the Vernier scale, and the **Dial Caliper**, which displays the fractional reading directly on a circular dial, eliminating the need to interpret the Vernier alignment. Both types are invaluable for laboratory work and quality control where measurements beyond a standard ruler's capability are required.

### Features

- **High Precision Measurement:** Provides readings with a high degree of precision, typically up to **002 mm** or **001 inch**, making it ideal for detailed laboratory experiments.
- **Multiple Measurement Modes:** Features **three sets of jaws and a depth rod** to accurately measure external dimensions, internal dimensions, and the depth of holes or recesses.
- **Durable Construction:** Built from hardened **stainless steel** or chrome plated metal for excellent durability, resistance to corrosion, and long term calibration stability.

**Zero Adjustment:** Includes a mechanism for **zeroing the scale** before use, ensuring the accuracy of all measurements by compensating for any minor wear or jaw misalignment.

- **Types Available:** Available in traditional **Mechanical Vernier** models requiring scale interpretation and **Dial** models offering faster, direct fractional readings via a clock face.

### **Specifications**

- **Measuring Range:** Available in common ranges such as **0 to 150 mm** (0 to 6 inches) or **0 to 300 mm** (0 to 12 inches).
- **Accuracy (Least Count):** High precision, typically  $\$0.02 \text{ ext{ mm}}\$$  (mechanical) or  $\$0.01 \text{ ext{ mm}}\$$  (dial) reading capability.
- **Material:** Hardened Stainless Steel or high quality tool steel.
- **Reading Format:** Available with **Metric** (millimeter) and **Imperial** (inch) scales, or dual scale models.
- **Application:** Used for length, external diameter, internal diameter, and depth measurements in physics and engineering labs.



## Energy Conversion Kit

Category: Heat-Energy-Conversion-Apparatus

### Description

- **Apparatus Type:** Educational set for demonstrating energy transformation.
- **Core Components:** Hand Crank Generator, DC Motor, Solar Panel or Cell, LED Module, and connecting cables.
- **Output Voltage:** DC output, typically low voltage (e.g., 1 V to 5 V DC) for safety and use with small components.
- **Demonstrations:** Kinetic energy, electrical energy, light energy, and solar energy transformation.
- **Required Input:** Requires manual input (hand cranking) or natural light (solar cell) as energy sources.

### Features

- **Multiple Conversions:** Facilitates the demonstration of several different energy transformations, including **mechanical to electrical, electrical to light, electrical to kinetic, and light to electrical**.
- **Modular Design:** Components are built on **sturdy, easy to connect bases** (often using banana plugs or magnetic terminals) for quick and flexible assembly of various experimental setups.

**Hands On Learning:** Provides an **engaging and interactive experience** for students to directly observe and measure energy transfer and conversion efficiency.

- **Renewable Energy Focus:** Highlights key principles of **renewable energy technologies**, particularly solar power and mechanical power generation.
- **Durability:** Components are housed in **robust plastic or metal casings** to withstand repeated use in a busy classroom or laboratory environment.

### **Specifications**

- **Apparatus Type:** Educational set for demonstrating energy transformation.
- **Core Components:** Hand Crank Generator, DC Motor, Solar Panel or Cell, LED Module, and connecting cables.
- **Output Voltage:** DC output, typically low voltage (e.g., 1 V to 5 V DC) for safety and use with small components.
- **Demonstrations:** Kinetic energy, electrical energy, light energy, and solar energy transformation.
- **Required Input:** Requires manual input (hand cranking) or natural light (solar cell) as energy sources.



## Thermoelectric Generator Kit

Category: Heat-Energy-Conversion-Apparatus

### Description

1. **Apparatus Type:** Solid state device for converting thermal energy to electrical energy.
2. **Core Component:** Semiconductor-based **Peltier module** (TEC).
3. **Output Type:** Generates **low voltage Direct Current (DC)**, typically a few volts at moderate temperature differences.
4. **Temperature Range:** Operates effectively with temperature differences typically between 20 degrees C and 80 degrees C.
5. **Required Input:** Requires an external heat source (hot water, heating plate) and a cooling method (cold water, ice, or heat sink) to establish a temperature gradient.

### Features

- **Seebeck Effect Demonstration:** Provides a clear, direct, and hands on demonstration of the fundamental **Seebeck effect**, where temperature differences produce an electric current.
- **Energy Conversion Study:** Excellent tool for studying **energy conversion efficiency** and the relationship between the

temperature gradient and the resulting electrical output voltage.

- **Bifunctional Module:** Includes a **Peltier module** that can be used not only as a generator but also as a cooler or heater when external current is applied (Peltier effect).
- **Complete System:** Often includes essential accessories such as a **heat sink** for the cold side, connecting wires, and a small voltmeter or LED to display the electrical output.
- **Clean Energy Concept:** Serves as a great starting point for discussing modern applications of **thermoelectric technology**, such as waste heat recovery and solid state cooling.

### Specifications

1. **Apparatus Type:** Solid state device for converting thermal energy to electrical energy.
2. **Core Component:** Semiconductor-based **Peltier module** (TEC).
3. **Output Type:** Generates **low voltage Direct Current (DC)**, typically a few volts at moderate temperature differences.
4. **Temperature Range:** Operates effectively with temperature differences typically between 20 degrees C and 80 degrees C.
5. **Required Input:** Requires an external heat source (hot water, heating plate) and a cooling method (cold water, ice, or heat sink) to establish a temperature gradient.



## Ball Ring Expansion Apparatus

Category: Heat-Energy-Conversion-Apparatus

### Description

- **Apparatus Type:** Demonstration tool for linear and volumetric thermal expansion.
- **Material:** Ball and Ring are typically made of **Brass** or **Copper**.
- **Ball Diameter:** Sized to fit snugly through the ring at ambient temperature.
- **Heating Requirement:** Requires an **external heat source** such as a Bunsen burner, alcohol lamp, or heating plate.
- **Safety:** Should be used with heat resistant gloves and under adult supervision due to the high temperatures involved.

### Features

- **Clear Demonstration:** Provides a highly effective and **visually engaging demonstration** of the thermal expansion of solid materials upon heating.
- **Qualitative Proof:** Clearly shows that heating causes a dimensional increase, confirming that the **volume and diameter of the ball increase** significantly upon temperature rise.
- **Durable Metal Components:** Constructed from robust metal,

typically brass or copper, ensuring **excellent thermal conductivity** for fast heating and reliable, repeatable results.

- **Handle Isolation:** Features **long insulating handles** on both the ball and the ring to protect the user from heat during the heating process.
- **Reversible Experiment:** Allows the user to demonstrate both **expansion by heating** and **contraction by cooling**, providing a complete understanding of the phenomenon.

### **Specifications**

- **Apparatus Type:** Demonstration tool for linear and volumetric thermal expansion.
- **Material:** Ball and Ring are typically made of **Brass** or **Copper**.
- **Ball Diameter:** Sized to fit snugly through the ring at ambient temperature.
- **Heating Requirement:** Requires an **external heat source** such as a Bunsen burner, alcohol lamp, or heating plate.
- **Safety:** Should be used with heat resistant gloves and under adult supervision due to the high temperatures involved.



## Calorimeter Double Wall Electric

Category: Heat-&-Energy-Conversion-Apparatus

### Description

This apparatus is a specialized **double wall calorimeter** designed for accurate measurement of **heat changes** (heat capacity, specific heat, heat of reaction) in laboratory experiments. It utilizes the standard method of mixing substances while minimizing heat loss to the surroundings. The **double wall construction** features an inner copper vessel held within a larger, insulated outer jacket (often air or vacuum filled), which acts as a thermal barrier to achieve **near adiabatic conditions**. Additionally, this electric model includes a **built in electric heater** and typically a thermometer hole and stirrer, allowing for precise control and measurement of heat energy added to the system, crucial for determining the **electrical equivalent of heat** or the specific heat of liquids.

### Features

- **Double Wall Insulation:** Features an **air or vacuum space** between the inner and outer vessels to significantly **reduce heat exchange** with the external environment, ensuring high measurement accuracy.
- **Integrated Electric Heater:** Includes a low voltage **heating coil** of known resistance, allowing for the precise introduction and measurement of heat energy ( $Q \text{ equals } I^2 R T$ ).
- **Accurate Measurement:** Designed to minimize the sources of error in calorimetry, making it an **ideal tool** for advanced experiments requiring high thermal isolation.

**Complete System:** Equipped with a lid that includes ports for an **electric stirrer** (to ensure uniform temperature) and a **thermometer or temperature sensor**.

- **Durable Construction:** Both inner and outer vessels are typically made of **polished copper** or aluminum, providing excellent thermal conductivity within the inner vessel and a low emissivity surface for the outer jacket.

### **Specifications**

- **Apparatus Type:** Double wall insulated vessel with integrated heating coil.
- **Vessel Material:** Inner and outer vessels typically made of **polished Copper** or Aluminum.
- **Heating Coil:** Resistance typically between 1 ohm and 10 ohm, requiring a low voltage power supply (e.g., 6 V or 12 V DC).
- **Capacity:** Varies by model, commonly 250ml or 500ml capacity for the inner vessel.
- **Accessories:** Includes a lid, stirrer, and terminals for heater connection.



## Standard Conductivity Cell

Category: Electricity-Magnetism-Equipment

### Description

- **Apparatus Type:** Two electrode glass cell for measuring electrolyte conductance.
- **Electrode Material:** Typically **Platinum** (often platinized with platinum black).
- **Cell Constant (K):** Available in standard values such as **10 cm<sup>-1</sup>**, **1 cm<sup>-1</sup>**, or **0.1 cm<sup>-1</sup>**, depending on the desired measurement range.
- **Temperature:** Suitable for use across a wide laboratory temperature range, typically 0 degrees C to 100 degrees C.
- **Application:** Used for conductometric titrations, measuring equivalent conductance, and quality control checks.

### Features

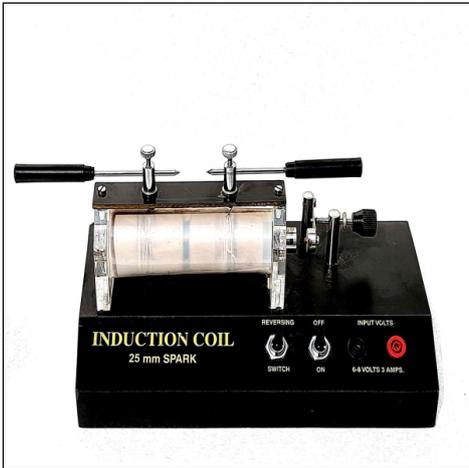
- **Precise Cell Constant:** Engineered with a **fixed, highly accurate electrode geometry** to provide a known and stable cell constant, ensuring reliable and repeatable conductivity measurements.
- **Inert Electrodes:** Typically features **platinum black electrodes** which are chemically inert and have a high surface area to minimize polarization effects during measurement.

**Durable Glass Body:** Constructed from robust laboratory **borosilicate glass** for chemical resistance and thermal stability during experimental procedures.

- **Easy Solution Access:** Designed with an opening or funnel top for **easy filling and rinsing** with the electrolyte solution being tested.
- **Standard Connection:** Equipped with secure, standardized **external terminals** for quick and reliable connection to a conductivity meter, resistance bridge, or LCR meter.

### Specifications

- **Apparatus Type:** Two electrode glass cell for measuring electrolyte conductance.
- **Electrode Material:** Typically **Platinum** (often platinized with platinum black).
- **Cell Constant (K):** Available in standard values such as **10 cm<sup>-1</sup>**, **1 cm<sup>-1</sup>**, or **0.1 cm<sup>-1</sup>**, depending on the desired measurement range.
- **Temperature:** Suitable for use across a wide laboratory temperature range, typically 0 degrees C to 100 degrees C.
- **Application:** Used for conductometric titrations, measuring equivalent conductance, and quality control checks.



## Induction Coil

Category: Electricity-Magnetism-Equipment

### Description

- **Apparatus Type:** Non-resonant pulse step up transformer (Ruhmkorff coil).
- **Spark Length:** Available in models producing maximum spark lengths of **25 mm, 50 mm**, or greater, indicating peak output voltage.
- **Input Voltage:** Requires a low voltage DC input, typically 6 V or 12 V DC (e.g., from a battery or low voltage power supply).
- **Output Voltage:** Produces highly intermittent high voltage spikes, typically ranging from 20kV to 100kV depending on spark length.
- **Accessories:** Often requires a separate low voltage DC power source and sometimes an external condenser for optimal performance.

### Features

- **High Voltage Generation:** The primary purpose is to transform a low voltage DC input into extremely high voltage pulses suitable for numerous physics demonstrations.
- **Versatile Use:** Essential for operating low pressure gas tubes like **Spectrum Discharge Tubes, Cathode Ray Tubes**, and conducting experiments in **wireless transmission** and discharge physics.

**Visible Discharge:** Provides an **impressive visual demonstration** of electromagnetic induction and high voltage discharge through the measurable spark length.

- **Mechanical Interrupter:** Features a reliable **contact breaker mechanism** or an electronic interrupter to rapidly interrupt the primary current, ensuring a sharp voltage increase in the secondary.
- **Robust Construction:** Built with heavy gauge copper wire, thick insulation, and a solid base for durability and safety during high voltage operation.

### **Specifications**

- **Apparatus Type:** Non-resonant pulse step up transformer (Ruhmkorff coil).
- **Spark Length:** Available in models producing maximum spark lengths of **25 mm, 50 mm**, or greater, indicating peak output voltage.
- **Input Voltage:** Requires a low voltage DC input, typically 6 V or 12 V DC (e.g., from a battery or low voltage power supply).
- **Output Voltage:** Produces highly intermittent high voltage spikes, typically ranging from 20kV to 100kV depending on spark length.
- **Accessories:** Often requires a separate low voltage DC power source and sometimes an external condenser for optimal performance.



## Van-De-Graaff Generator

Category: Electricity-Magnetism-Equipment

### Description

- **Apparatus Type:** Electrostatic belt driven generator.
- **Generator Components:** Insulating belt, lower and upper pulleys, charging source, and large metal collector sphere.
- **Voltage Output:** Varies by model size, typically ranging from 100 kV (small benchtop) to over 400 kV (floor standing).
- **Power Source:** Operates using a standard 110 V or 220 V AC motor to drive the belt, or occasionally hand cranked.
- **Accessories:** Includes a separate **discharge sphere** on an insulated stand.

### Features

- **High Voltage Generation:** Capable of creating very high electrostatic voltages, often reaching **hundreds of thousands of volts**, suitable for dramatic classroom demonstrations.
- **Electrostatics Study:** Provides the **best visual and hands-on tool** for demonstrating key principles like charge transfer, electric fields, and static potential energy.
- **Collector Sphere:** Features a large, polished metal sphere designed for **maximum charge accumulation** and minimum

leakage into the surrounding air.

- **Continuous Operation:** Unlike friction-based machines, the motor-driven belt allows for **continuous generation and accumulation** of charge, providing stable output for experiments.
- **Safety Design:** Includes safety features such as a **grounding discharge ball** on an insulating rod to safely discharge the large stored potential after use.

### Specifications

- **Apparatus Type:** Electrostatic belt driven generator.
- **Generator Components:** Insulating belt, lower and upper pulleys, charging source, and large metal collector sphere.
- **Voltage Output:** Varies by model size, typically ranging from 100 kV (small benchtop) to over 400 kV (floor standing).
- **Power Source:** Operates using a standard 110 V or 220 V AC motor to drive the belt, or occasionally hand cranked.
- **Accessories:** Includes a separate **discharge sphere** on an insulated stand.



## Wimshurst Machine

Category: Electricity-Magnetism-Equipment

### Description

- **Apparatus Type:** Frictionless electrostatic induction machine.
- **Generators:** Two counter-rotating discs with multiple metal sectors.
- **Charge Storage:** Includes two integrated **Leyden Jars** (primitive capacitors).
- **Output:** Generates high voltage, low current static electricity, typically **tens of thousands of volts**.
- **Operation:** Manually operated via a hand crank and requires relatively **dry air conditions** for optimal performance.

### Features

1. **High Voltage Generation:** Capable of generating thousands of volts of **static electricity**, producing impressive spark discharges in dry conditions.
2. **Electrostatic Induction:** Provides a clear, mechanical demonstration of the principles of charge separation and **electrostatic induction**.
3. **Leyden Jar Capacitors:** Includes two built-in Leyden Jars

to **store the generated charge**, allowing for a larger, more energetic spark when discharged.

4. **Counter Rotating Discs:** Features two acrylic or glass discs mounted to rotate smoothly in **opposite directions**, a design that maximizes charge generation efficiency.
5. **Durable Construction:** Built with sturdy, insulated materials and a reliable hand crank mechanism for **long term educational use** in physics laboratories.

### Specifications

- **Apparatus Type:** Frictionless electrostatic induction machine.
- **Generators:** Two counter-rotating discs with multiple metal sectors.
- **Charge Storage:** Includes two integrated **Leyden Jars** (primitive capacitors).
- **Output:** Generates high voltage, low current static electricity, typically **tens of thousands of volts**.
- **Operation:** Manually operated via a hand crank and requires relatively **dry air conditions** for optimal performance.



## Tesla Coil

Category: Electricity-Magnetism-Equipment

### Description

- **Circuit Type:** Resonant transformer circuit (primary and secondary coils).
- **Output Voltage:** Varies significantly by model, typically from 50 ext kV (small models) up to \$500 ext kV or more (large models).
- **Operating Frequency:** High radio frequency, usually in the range of 50 ext kHz to \$500 ext kHz.
- **Power Input:** Standard 110 ext V or \$220 ext V AC input, requiring specific current ratings based on model size.
- **Models Available:** Spark Gap Tesla Coil (SGTC) and Solid State Tesla Coil (SSTC).

### Features

- **High Voltage Generation:** Capable of producing very high voltage output, resulting in visually stunning and informative **electrical discharges** (sparks, streamers).
- **Resonance Demonstration:** An excellent tool for teaching the principle of **electrical resonance** and high frequency oscillation circuits.
- **Wireless Transmission:** Can be used to demonstrate the

fundamentals of **wireless energy transfer** and electromagnetic wave propagation.

- **Variety of Models:** Available in **various sizes and power levels**, from small spark gap models suitable for classroom safety demonstrations to solid state models with modulated audio for musical arcs.
- **Safety Enclosure:** Includes a sturdy, insulated base and safety warnings. **Strict adherence to operating instructions** is required due to the high voltages produced.

### **Specifications**

- **Circuit Type:** Resonant transformer circuit (primary and secondary coils).
- **Output Voltage:** Varies significantly by model, typically from \$50 ext{ kV}\$ (small models) up to \$500 ext{ kV}\$ or more (large models).
- **Operating Frequency:** High radio frequency, usually in the range of \$50 ext{ kHz}\$ to \$500 ext{ kHz}\$.
- **Power Input:** Standard \$110 ext{ V}\$ or \$220 ext{ V}\$ AC input, requiring specific current ratings based on model size.
- **Models Available:** Spark Gap Tesla Coil (SGTC) and Solid State Tesla Coil (SSTC).



## Zeeman Tube Power Supply (110V 220V)

Category: Electronic-Equipments

### Description

- **Input Voltage:** Selectable or Auto-Sensing for \$110 ext{ V}\$ to \$220 ext{ V}\$ AC, \$50\$ to \$60 ext{ Hz}\$.
- **Output Voltage:** High Voltage AC or DC output, typically \$2 ext{ kV}\$ to \$5 ext{ kV}\$ (depending on the tube requirement).
- **Regulation:** Highly regulated output for stable spectral emission.
- **Protection:** Overload and short circuit protection with integrated current limiting.
- **Terminals:** High quality, insulated output terminals for secure connection to the discharge tube.

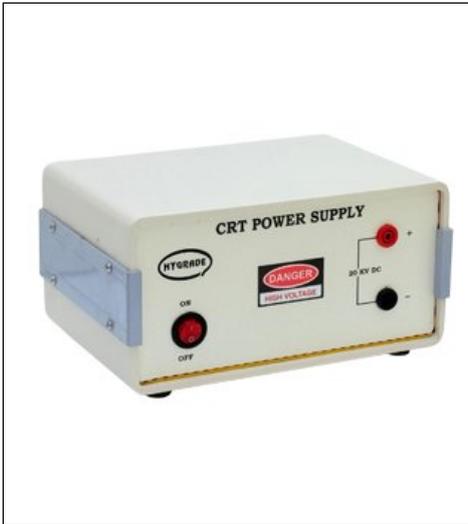
### Features

- **Dual Voltage Compatibility:** Features a robust input selector or internal circuit that allows operation on both **\$110 ext{ V}\$ and \$220 ext{ V}\$ AC** power grids, making it universally suitable for research and teaching labs.
- **Stable High Voltage:** Provides a **regulated and consistent high voltage DC or AC output**, which is necessary for maintaining the tube plasma and preventing flicker or intensity variations.
- **Tube Protection:** Incorporates **safety mechanisms** like current limiting circuitry to prevent premature damage or burn-out of the expensive, fragile Zeeman discharge tubes.
- **Optimized Output:** The voltage and current output are carefully tuned to maximize the **light intensity and spectral purity** of the Mercury or Neon tubes.
- **Safe Operation:** Housed in a durable, **fully insulated enclosure** with

clearly marked, secure terminals to minimize electrical hazards during high voltage operation.

### **Specifications**

- **Input Voltage:** Selectable or Auto-Sensing for 110 V to 220 V AC, 50 to 60 Hz.
- **Output Voltage:** High Voltage AC or DC output, typically 2 kV to 5 kV (depending on the tube requirement).
- **Regulation:** Highly regulated output for stable spectral emission.
- **Protection:** Overload and short circuit protection with integrated current limiting.
- **Terminals:** High quality, insulated output terminals for secure connection to the discharge tube.



## Cathode Ray Tube HT Power Supply

Category: Electronic-Equipments

### Description

- **Input Voltage:** Selectable or Auto-Sensing for  $110\text{ V}$  to  $220\text{ V}$  AC,  $50\text{ Hz}$  to  $60\text{ Hz}$ .
- **Filament Output:** Low voltage DC output, typically  $6\text{ V}$  to  $12\text{ V}$  DC.
- **Anode Output:** High voltage DC output, typically  $1\text{ kV}$  to  $5\text{ kV}$  DC (depending on the CRT requirement).
- **Protection:** Short circuit protection and current limiting on high voltage lines.
- **Enclosure:** Robust, insulated metal or plastic housing with grounded connections.

### Features

- **Dual Voltage Input:** Designed with an input selector or auto-sensing circuitry to operate safely on both  $110\text{ V}$  and  $220\text{ V}$  AC power supplies, offering maximum flexibility.
- **Multiple Outputs:** Delivers all necessary voltages simultaneously, including **low voltage DC** for the filament and **high voltage DC** for the electron acceleration (anode).
- **Safety Focus:** Incorporates **internal current limiting and protective fusing** to prevent damage to the delicate CRT and ensure user safety during high voltage experiments.

**Stable Performance:** Provides a **regulated and stable high voltage output**, which is critical for maintaining a focused, consistent electron beam and obtaining clear experimental results.

- **Clear Controls:** Equipped with **clearly labeled output terminals** and simple controls, including a power switch and indicator lamp, for easy and intuitive laboratory setup.

### **Specifications**

- **Input Voltage:** Selectable or Auto-Sensing for 110 V to 220 V AC, 50 to 60 Hz.
- **Filament Output:** Low voltage DC output, typically 6 V to 12 V DC.
- **Anode Output:** High voltage DC output, typically 1 kV to 5 kV DC (depending on the CRT requirement).
- **Protection:** Short circuit protection and current limiting on high voltage lines.
- **Enclosure:** Robust, insulated metal or plastic housing with grounded connections.



## Lamps(Sodium, Mercury)

Category: Vacuum-Apparatus-Specialization

### Description

- **Lamp Type:** Low pressure vapor discharge lamp.
- **Fill Gas:** Available as pure **Sodium vapor (Na)** or pure **Mercury vapor (Hg)**.
- **Required Power:** Requires a **dedicated High Reactance Ballast or Power Supply** with specific starting and operating voltage requirements.
- **Wattage:** Typically low power, in the range of 35 Watts to 100 Watts, optimized for lab use.
- **Base Type:** Standard bulb base or specialized laboratory socket base for secure connection to the power unit.

### Features

- **Monochromatic Source:** Sodium lamps provide a highly monochromatic, **bright yellow light**, simplifying optical measurements in interference and diffraction experiments.
- **Spectral Calibration:** Mercury lamps emit **multiple distinct and sharp spectral lines**, making them indispensable for calibrating spectrometers and diffraction gratings.
- **High Intensity:** The lamps are designed to produce a **high**

**intensity light output** for easy visualization and accurate measurement in laboratory settings.

- **Long Lifespan:** Built with durable glass envelopes and robust electrodes to ensure a **long operational life** and consistent spectral output over many uses.
- **Easy Integration:** Designed to plug easily into a **dedicated lamp power supply unit**, which is required to provide the high voltage necessary for lamp ignition and stable operation.

### Specifications

- **Lamp Type:** Low pressure vapor discharge lamp.
- **Fill Gas:** Available as pure **Sodium vapor (Na)** or pure **Mercury vapor (Hg)**.
- **Required Power:** Requires a **dedicated High Reactance Ballast or Power Supply** with specific starting and operating voltage requirements.
- **Wattage:** Typically low power, in the range of 35 Watts to 100 Watts, optimized for lab use.
- **Base Type:** Standard bulb base or specialized laboratory socket base for secure connection to the power unit.



## Radiometer

Category: Vacuum-Apparatus-Specialization

### Description

- **Apparatus Type:** Evacuated glass bulb with internal rotor assembly.
- **Rotor Assembly:** Four lightweight metal vanes, mounted on a central spindle.
- **Vane Coating:** One side of each vane is **blackened** and the opposite side is **polished**.
- **Required Energy Source:** Operates when exposed to any strong source of **electromagnetic radiation** (visible light, infrared heat).
- **Internal Pressure:** Contains an internal **partial vacuum** (low pressure), which is essential for the molecular repulsion mechanism to function.

### Features

- **Visual Energy Conversion:** Offers a **clear and dramatic demonstration** of how light and radiant heat energy can be directly converted into **mechanical rotational energy**.
- **Kinetic Theory Illustration:** Excellent apparatus for illustrating the **kinetic theory of gases** and the effect of molecular collisions in a low pressure environment.

**Sensitive Operation:** Highly sensitive rotor design ensures that even low levels of **ambient light or heat** are sufficient to initiate rotation.

- **Low Friction Build:** Features a precision engineered, **low friction spindle bearing** to minimize energy loss and maximize the rotor spin speed and duration.
- **Durable Construction:** Built with a **robust, evacuated glass bulb** to maintain the necessary partial vacuum required for the effect, ensuring long term operational reliability.

### Specifications

- **Apparatus Type:** Evacuated glass bulb with internal rotor assembly.
- **Rotor Assembly:** Four lightweight metal vanes, mounted on a central spindle.
- **Vane Coating:** One side of each vane is **blackened** and the opposite side is **polished**.
- **Required Energy Source:** Operates when exposed to any strong source of **electromagnetic radiation** (visible light, infrared heat).
- **Internal Pressure:** Contains an internal **partial vacuum** (low pressure), which is essential for the molecular repulsion mechanism to function.



## Zeeman Discharge Tube (Mercury/Neon)

Category: Vacuum-Apparatus-Specialization

### Description

- **Tube Type:** Low-pressure, narrow-bore gas discharge tube (Geissler tube configuration).
- **Fill Gas:** High-purity **Mercury or Neon** vapor.
- **Geometry:** Designed with a **narrow viewing window** to allow the light emission to be observed precisely along or across the axis of the applied magnetic field.
- **Required External Apparatus:** Must be used in conjunction with a **Powerful Electromagnet** and a **High-Resolution Spectrometer**.

### Features

- **Zeeman Effect Demonstration:** The **primary apparatus** for visually and photographically demonstrating the splitting of spectral lines, a cornerstone experiment in quantum mechanics and atomic physics.
- **High Purity Gas:** Contains high-purity **Mercury or Neon** vapor, selected for their clear spectral signatures and large splitting factors, ensuring observable results even with moderately strong magnets.
- **High Luminosity:** Engineered to provide **intense, narrow spectral emission** when energized, which is essential for successful resolution of the split lines by a spectrometer.
- **Compatibility:** Specifically designed for insertion into the narrow gap between the pole pieces of a **high-field laboratory electromagnet**,

allowing the light to pass through the magnetic field lines.

- **Educational Value:** Offers an advanced practical method for students to measure the **specific charge of the electron ( $e/m$ )** or the **Landé g-factor** by analyzing the line separation distance.

### **Specifications**

- **Tube Type:** Low-pressure, narrow-bore gas discharge tube (Geissler tube configuration).
- **Fill Gas:** High-purity **Mercury or Neon** vapor.
- **Geometry:** Designed with a **narrow viewing window** to allow the light emission to be observed precisely along or across the axis of the applied magnetic field.
- **Required External Apparatus:** Must be used in conjunction with a **Powerful Electromagnet** and a **High-Resolution Spectrometer**.



## Cathode Ray Tube (X-Ray)

Category: Vacuum-Apparatus-Specialization

### Description

- **Tube Type:** High-vacuum diode tube (Coolidge type) with a heated filament.
- **Anode/Target:** Tungsten or Molybdenum target embedded in a cooling block.
- **Cooling Requirement:** May require **forced air or water cooling** of the target anode depending on power rating and duty cycle.

### Features

- **Controlled X-ray Generation:** Produces a beam of X-rays when powered, enabling experiments and demonstrations on the properties of this **high-energy electromagnetic radiation** (e.g., penetration, absorption).
- **Heated Filament Cathode:** Utilizes thermionic emission from a heated filament to ensure a **reliable, high-intensity source** of electrons, providing stable and predictable X-ray output.
- **Target Material:** The anode features a high-melting-point, high-atomic-number metal target, typically **Tungsten**, which efficiently converts the kinetic energy of the electrons into X-rays.

### Specifications

**Tube Type:** High-vacuum diode tube (Coolidge type) with a heated filament.

- **Anode/Target:** Tungsten or Molybdenum target embedded in a cooling block.
- **Cooling Requirement:** May require **forced air or water cooling** of the target anode depending on power rating and duty cycle.



## Cathode Ray Tube Cross And Shadow

Category: Vacuum-Apparatus-Specialization

### Description

- **Tube Type:** High-vacuum diode tube featuring a fixed or movable internal metal obstruction.
- **Internal Obstruction:** A precisely crafted **metal cross** that serves as the anode/shadow-caster.
- **Screen Coating:** Internal layer of highly sensitive **cathodoluminescent phosphor** (typically emitting a visible green light).
- **Operating Voltage:** Requires a dedicated **High-Voltage Power Supply** providing high potential for electron acceleration and a low voltage for the cathode filament.

### Features

hi

### Specifications

- **Tube Type:** High-vacuum diode tube featuring a fixed or movable internal metal obstruction.
- **Internal Obstruction:** A precisely crafted **metal cross** that serves as the anode/shadow-caster.
- **Screen Coating:** Internal layer of highly sensitive **cathodoluminescent phosphor** (typically emitting a visible green light).
- **Operating Voltage:** Requires a dedicated **High-Voltage Power Supply**

providing high potential for electron acceleration and a low voltage for the cathode filament.



## Cathode Ray Tube

Category: Vacuum-Apparatus-Specialization

### Description

- **Tube Type:** High-vacuum diode tube (historically a Crookes or Braun tube variant).
- **Screen:** Flat or slightly curved faceplate coated internally with a **cathodoluminescent phosphor** (often zinc sulfide, emitting a green glow).
- **Operating Voltage:** Requires a **High-Voltage Power Supply** providing 1,000 V to 5,000 V for acceleration (anode) and a low voltage for the filament (cathode heating).
- **Electrodes:** Includes a heated filament/cathode, an anode, and typically additional control/focus electrodes.
- **Compatibility:** Designed for use with external **Deflection Coils** or **High-Voltage CRT Power Supply**.

### Features

- **Clear Fluorescence:** Features a **phosphor-coated screen** that generates a bright, visible spot or trace when struck by the electron beam, clearly demonstrating the conversion of kinetic energy into light.
- **Electron Deflection Study:** Designed to be used with external **electric or magnetic deflection coils** (not included) to show the effect of fields on the electron beam, confirming the negative

charge of the cathode rays.

- **High Vacuum Build:** Constructed from robust, thick-walled glass to maintain a high internal vacuum, which is necessary to **prevent electron scattering** and ensure a straight, focused beam path.
- **Fundamental Physics:** An **indispensable educational tool** for illustrating key historical experiments by figures like J. J. Thomson and for explaining the fundamental structure of matter and electricity
- **Safe Operation:** Equipped with internal components and robust connection points for reliable and safe use with a dedicated high-voltage power supply.

### Specifications

- **Tube Type:** High-vacuum diode tube (historically a Crookes or Braun tube variant).
- **Screen:** Flat or slightly curved faceplate coated internally with a **cathodoluminescent phosphor** (often zinc sulfide, emitting a green glow).
- **Operating Voltage:** Requires a **High-Voltage Power Supply** providing 1,000 V to 5,000 V for acceleration (anode) and a low voltage for the filament (cathode heating).
- **Electrodes:** Includes a heated filament/cathode, an anode, and typically additional control/focus electrodes.
- **Compatibility:** Designed for use with external **Deflection Coils** or **High-Voltage CRT Power Supply**.



## Spectrum Discharge Tube Power Supply

Category: Electronic-Equipments

### Description

- **Output Voltage (V):** Selectable or fixed output, typically in the range of 2,000 V to 5,000 V AC or DC.
- **Input Voltage (V):** Standard laboratory line voltage.
- **Load Protection:** Integrated current limiting mechanism for tube safety.
- **Output Terminals:** Well-insulated, high-voltage posts for secure connection to discharge tube electrodes.
- **Indicators:** Power ON/OFF indicator lamp.

### Features

- **Optimized Output:** Delivers the precise **high voltage** (typically several thousand volts) required to efficiently light all standard elemental discharge tubes.
- **Current Limiting:** Incorporated safety circuitry **limits the output current** to protect delicate glass tubes from damage and prevent premature burn-out.
- **Safety Focused:** Features high-quality insulation, fused inputs, and grounded chassis design to ensure **maximum safety** for students and laboratory personnel during operation.

**Stability and Reliability:** Provides a highly **stable and regulated voltage output**, guaranteeing consistent light intensity and a clear, unwavering spectrum for measurement.

- **Ease of Use:** Equipped with **clearly marked output terminals** and simple controls (e.g., an ON/OFF switch and indicator lamp) for quick and straightforward laboratory setup.

### **Specifications**

- **Output Voltage (V):** Selectable or fixed output, typically in the range of 2,000 V to 5,000 V AC or DC.
- **Input Voltage (V):** Standard laboratory line voltage.
- **Load Protection:** Integrated current limiting mechanism for tube safety.
- **Output Terminals:** Well-insulated, high-voltage posts for secure connection to discharge tube electrodes.
- **Indicators:** Power ON/OFF indicator lamp.