REINHOLD ENVIRONMENTAL ®

2025 Reinhold/PCUG Round Table Presentation

Hosted by AEP and Buckeye Power

in The Hilton Columbus Polaris Hotel, Columbus, OH

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2025 REINHOLD/PCUG CONFERENCE

Precipitators 101

Paul Ford
President

P (908) 369-1590
F (908) 369-1594
paul.ford@redkoh.com
300 Valley Road **|** Hillsborough, NJ 08844
www.redkoh.com

"The Redkoh Group provides solutions that enable an integrated approach to pollution control and monitoring"

Redkoh Industries has been manufacturing electrostatic precipitator controls for over 30 years. We have manufactured analog, solid state, and microprocessor type controls for the air pollution control industry in the USA.

Redkoh supplies controls to Electrostatic Precipitator Manufacturers and to End Users throughout the world.

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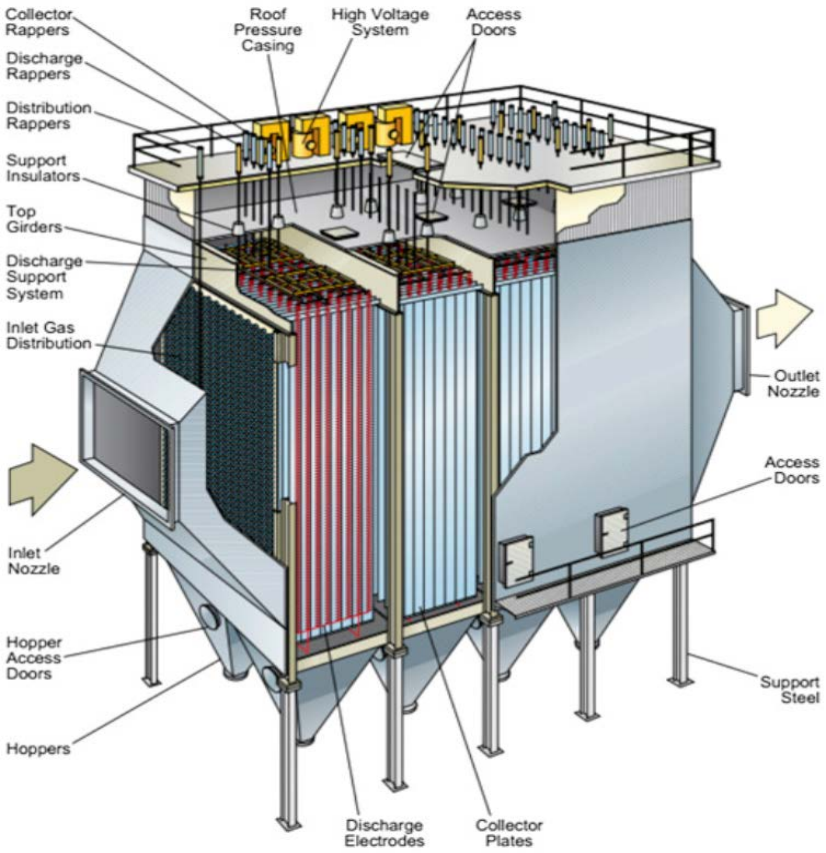
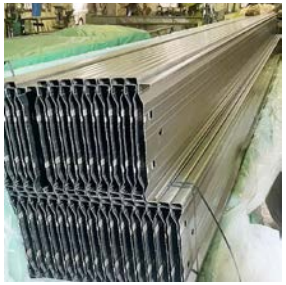
Precipitator

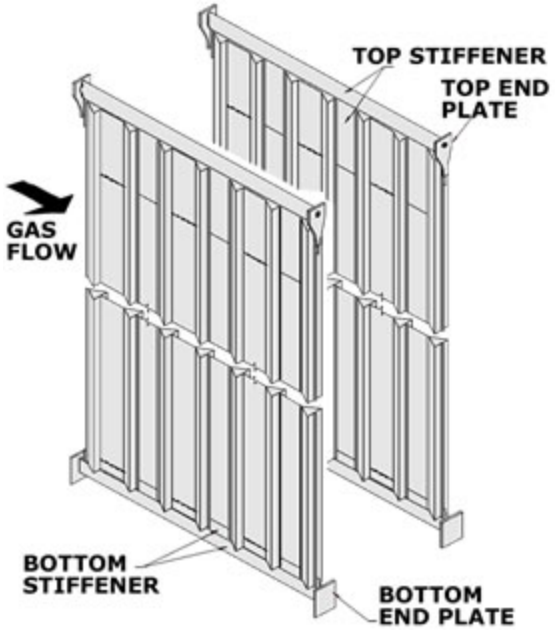


Collector Plate / Electrode

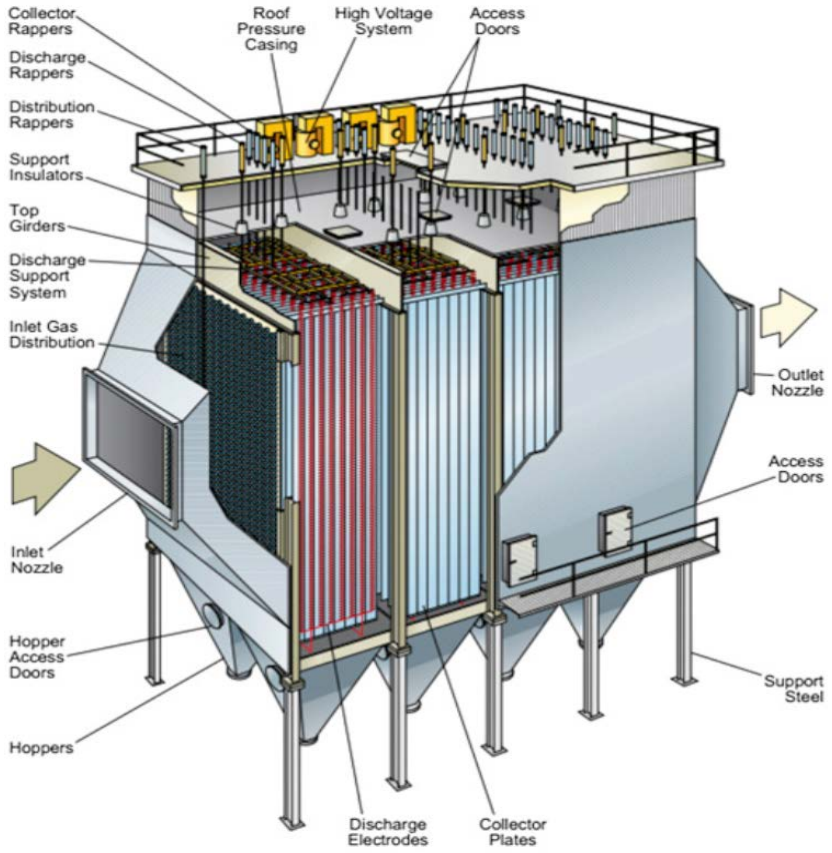
Collector Plate / Electrode

- This is a crucial component of an electrostatic precipitator (ESP) system.
- It is designed to receive and retain precipitated particles from the gas stream until they are removed for further processing.
- The collector plates are typically at earth potential
- We will see how the collector plate receives the particles and how they are removed in later slides



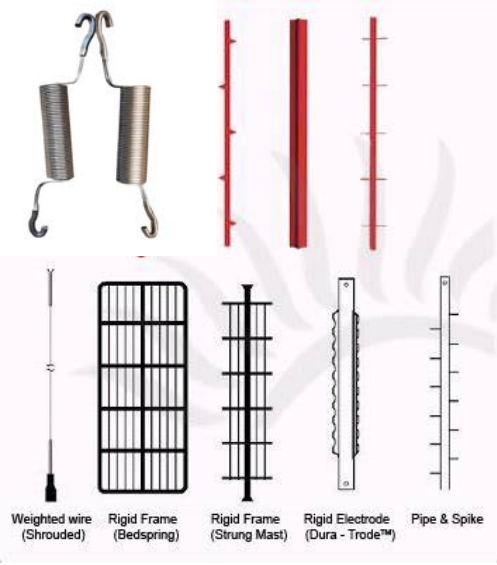


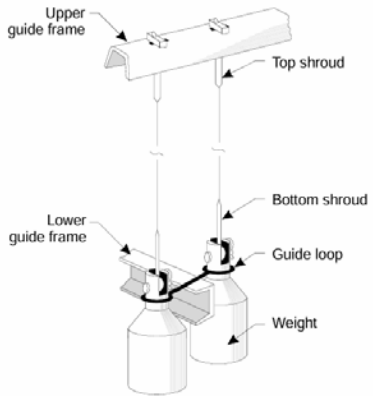
Precipitator



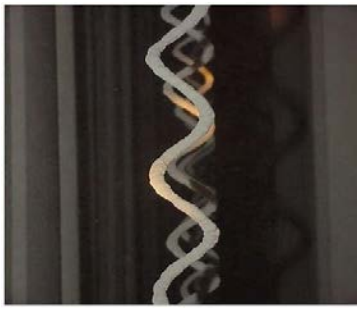
Discharge Electrode

Discharge Electrode





- The selection of discharge electrode types in electrostatic precipitators is vital for:
  - Optimizing performance
  - Managing operational efficiency
- The following factors contribute to their effectiveness in different applications:
  - Material properties,
  - Electrical characteristics, and design configurations
- For industries relying on particulate control, choosing the right type of discharge electrode is critical to achieving compliance and operational efficiency.



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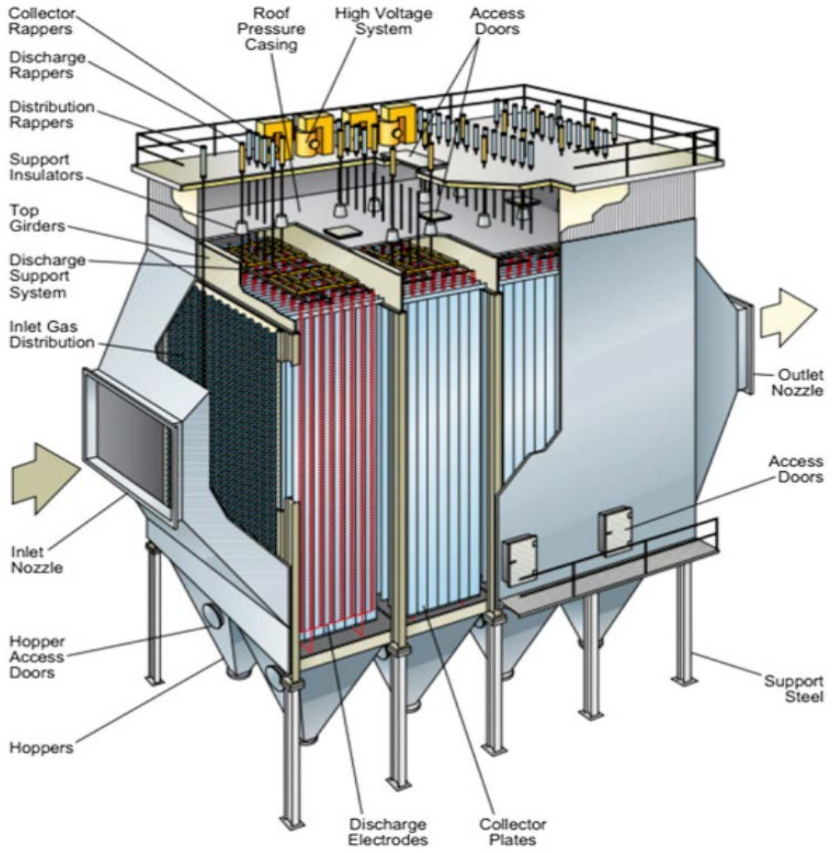
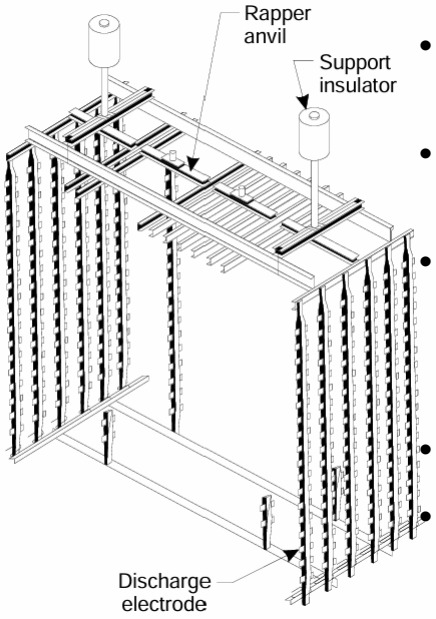
Precipitator



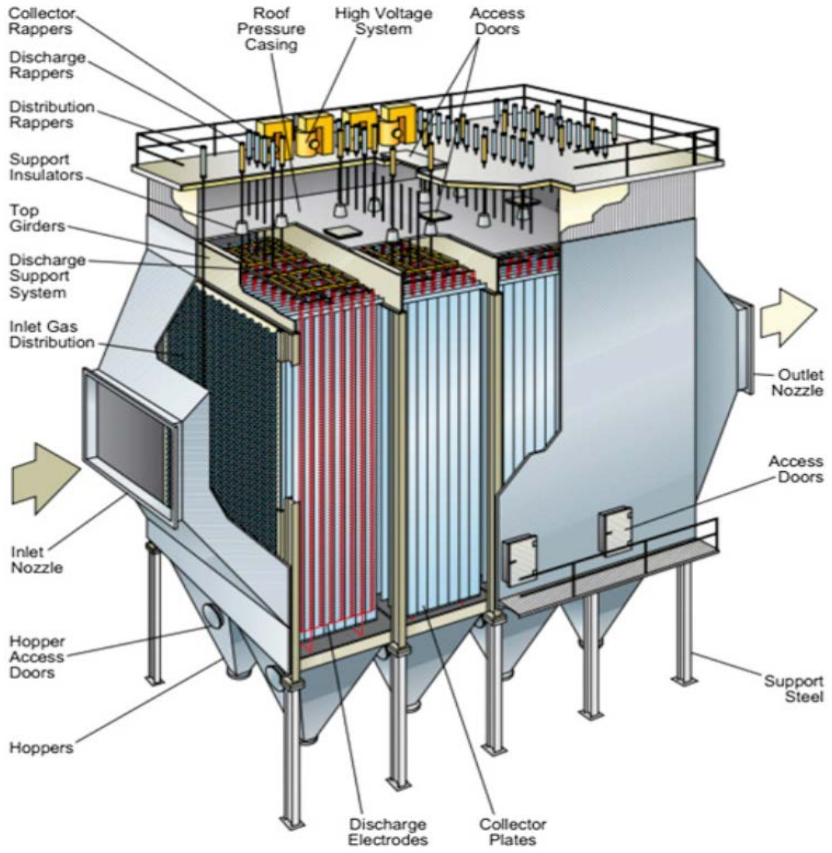
Support Insulator

Support Insulator



- This is a critical ceramic component that serves both mechanical and electrical functions.
- They support and electrically isolate the high-voltage discharge electrodes from the ESP housing.
- The electrodes are structurally attached to a suspension system that the insulator holds.
- These insulators are typically made from highly resistant ceramic materials (up to180°C or high-alumina porcelain (up to 400°C) alumina with alumina oxide content up to 95%
- The reliability of these support insulators is crucial.
- Failures lead to:
  - Electrical field shorts and
  - Potential collapse of the high-voltage frame

Precipitator



Purge Air Systems

Purge Air Systems

- A purge air heater blower is a crucial component within the ESP system.
- Its primary function is to provide a controlled flow of heated air to prevent dust accumulation and moisture-related issues within the high-voltage insulator enclosures.
- Its Key Functions are to:
  - Prevents Dust Migration up into the insulators
  - Maintains Dry Conditions: Heated air prevents condensation on the insulator surfaces
  - Keeping insulators clean and dry, the blower helps minimize stress, cracking and electrical insulation
  - Heated purge air prevents dew-point corrosion, extending the lifespan of ESP components.
- The purge air heater blower operates by drawing in ambient air, heating it to a specific temperature, and directing it into the ESP's insulator enclosures.
- This controlled airflow prevents moisture buildup and ensures that the insulators remain free from dust and contaminants.

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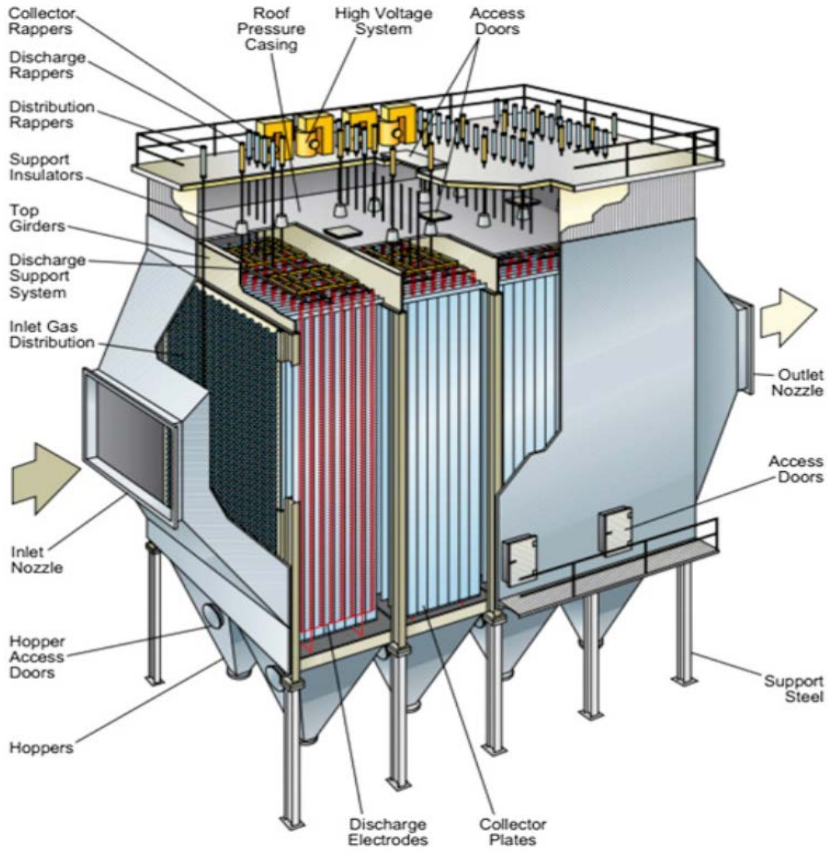
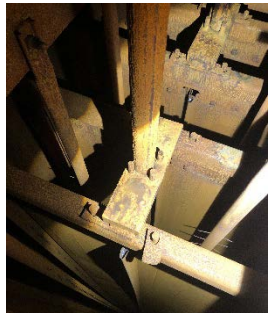
Precipitator



Collector Plate MIGI Rappers

Collector Plate MIGI Rappers

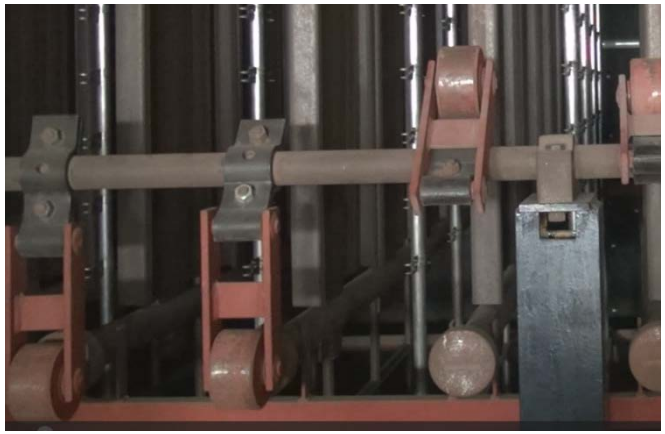
- The collector plate rapper on an electrostatic precipitator is responsible for removing the accumulated ash layer from the collector plates.
- This process is crucial for maintaining the efficiency and performance of the ESP.
- The rapping system applies mechanical impacts to the plates, which in turn dislodges the collected particles.
- The impact is created by an electromagnet lifting a heavy metal rod to a pre-determined height and dropping it onto metal rod connected to an anvil affixed to the top of the collector plate.
- The frequency and intensity of the rapping are determined by factors such as particle adhesion properties and the thickness of the accumulated ash layer.
- Operators must balance these factors to optimize the cleaning cycle and maintain collection efficiency without causing re-entrainment, where particles are knocked loose only to be caught again in the airflow.



Collector Plate
Tumble Hammer Rappers

Collector Plate
Tumble Hammer Rappers

- The function of this type of rapper is the same as that shown in the previous slide with the following difference:
- The impact is created by a hammer affixed to a rotating shaft that spans the width of the precipitator
- As the shaft rotates, and once the rapper passes its center of gravity it falls dropping onto an anvil affixed to the side of the collector plate.
- The frequency of the rapping are determined by factors such as particle adhesion properties and the thickness of the accumulated ash layer.
- The intensity is determined during design by selecting the hammer weight and its shaft length



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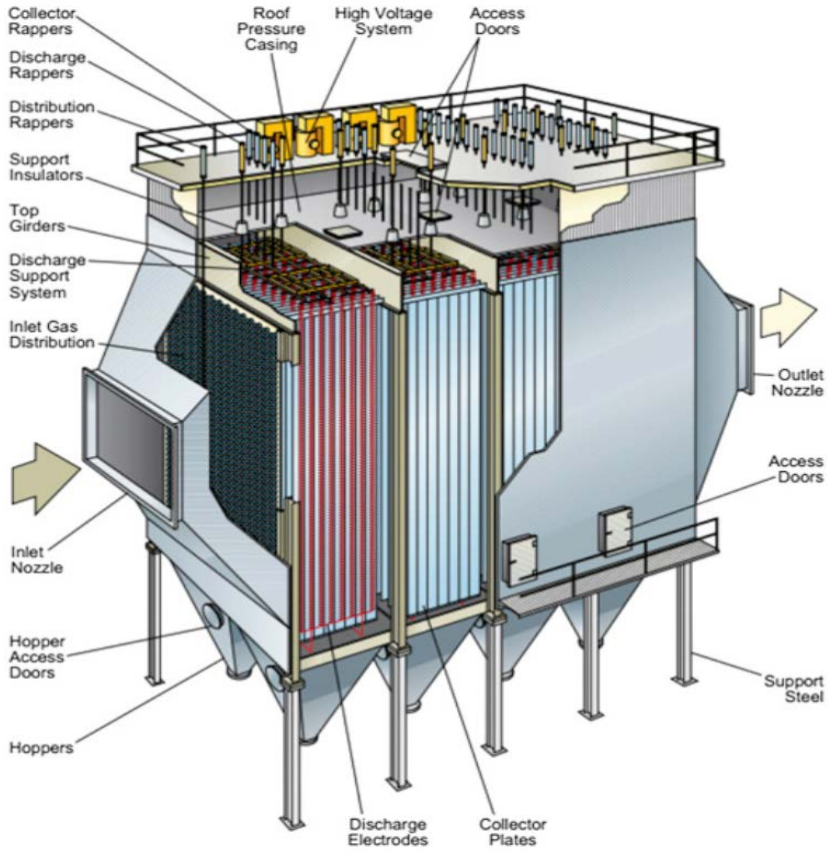
Precipitator



Discharge Electrode MIGI Rappers

Discharge Electrode MIGI Rappers

- The discharge electrode rapper on an electrostatic precipitator is responsible for removing the accumulated ash layer from the discharge electrodes.
- This process is crucial for maintaining the efficiency and performance of the ESP.
- The rapping system applies mechanical impacts to the electrodes, which in turn dislodges the collected particles.
- The impact is created by an electromagnet lifting a heavy metal rod to a pre-determined height and dropping it onto an insulated rod of either ceramic / alumina or FRP connected to an anvil affixed to the top of the discharge electrode frame.
- Keeping the electrodes clean and free of particulate allows them to maintain a high level of ionization required for collection within the precipitator.
- The frequency and intensity of the rapping are determined by factors such as particle adhesion properties and the thickness of the accumulated ash layer.

Discharge Electrode Tumble Hammer Rappers

Discharge Electrode Tumble Hammer Rappers

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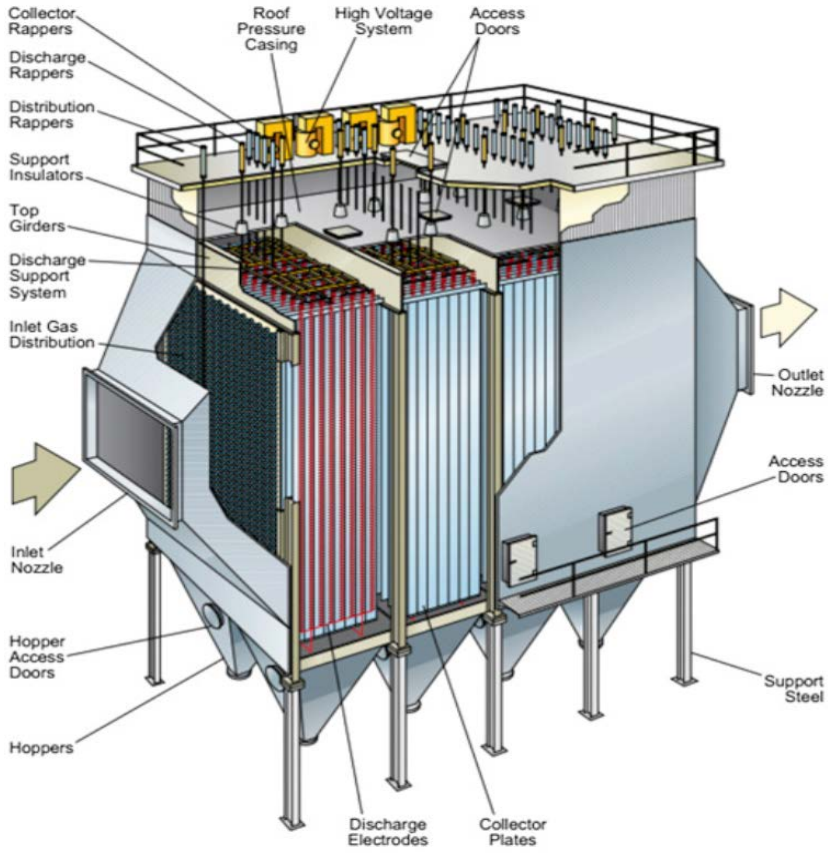
- The function of this type of rapper is the same as that shown in the previous slide with the following difference:
- The impact is created by a hammer affixed to a rotating shaft that spans the width of the precipitator.
- The shaft is driven by a motor with a high ratio gearbox mounted outside the precipitator.
- As the shaft rotates, and once the rapper passes its center of gravity it falls dropping onto an anvil affixed to the top of the discharge electrode.
- The frequency of the rapping are determined by factors such as particle adhesion properties and the thickness of the accumulated ash layer.
- The intensity is determined during design by selecting the hammer weight and its shaft length

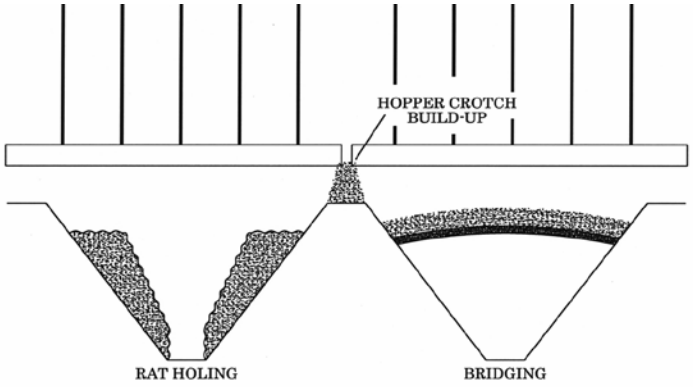
Precipitator



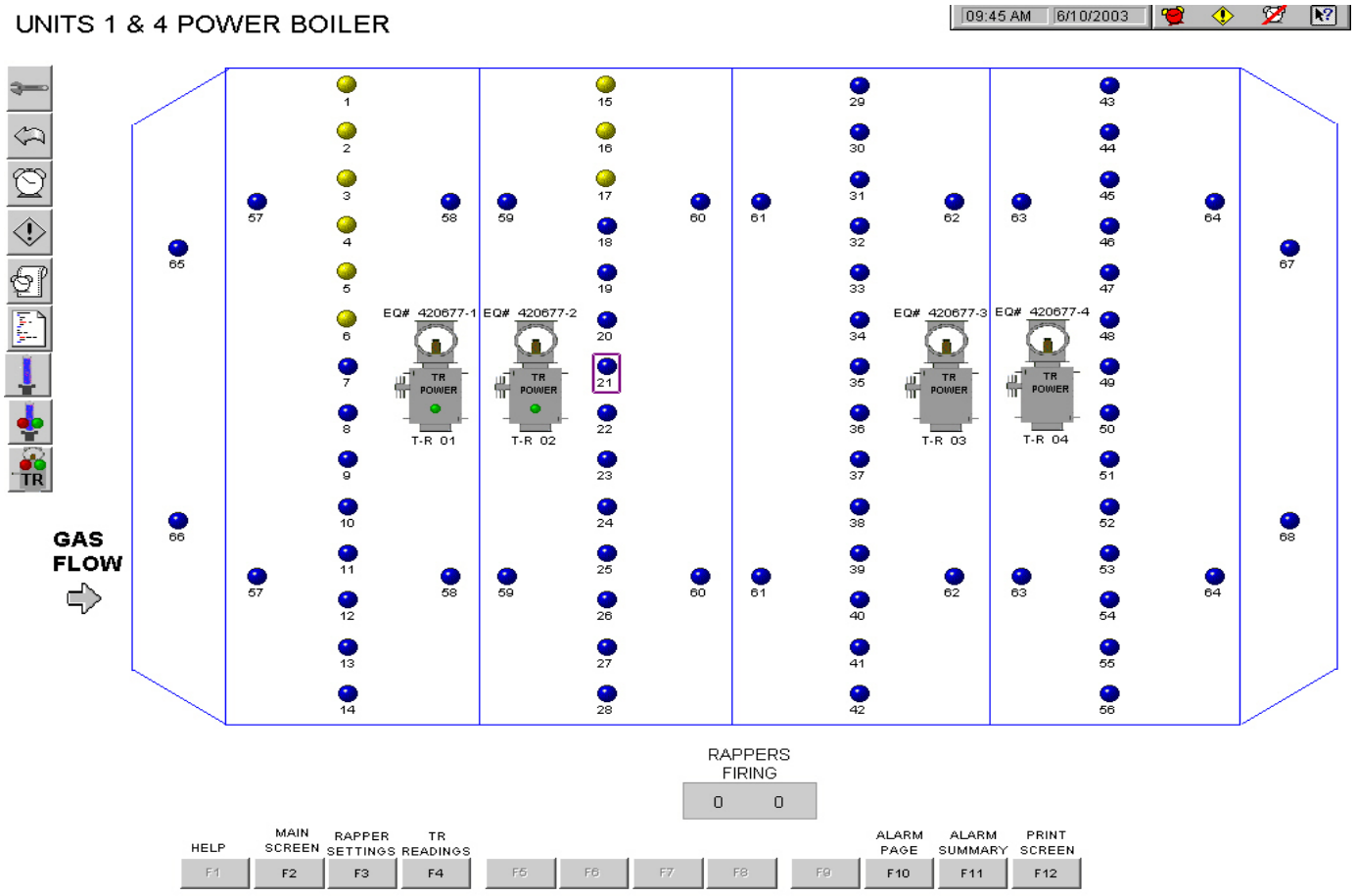
Hoppers

Hoppers

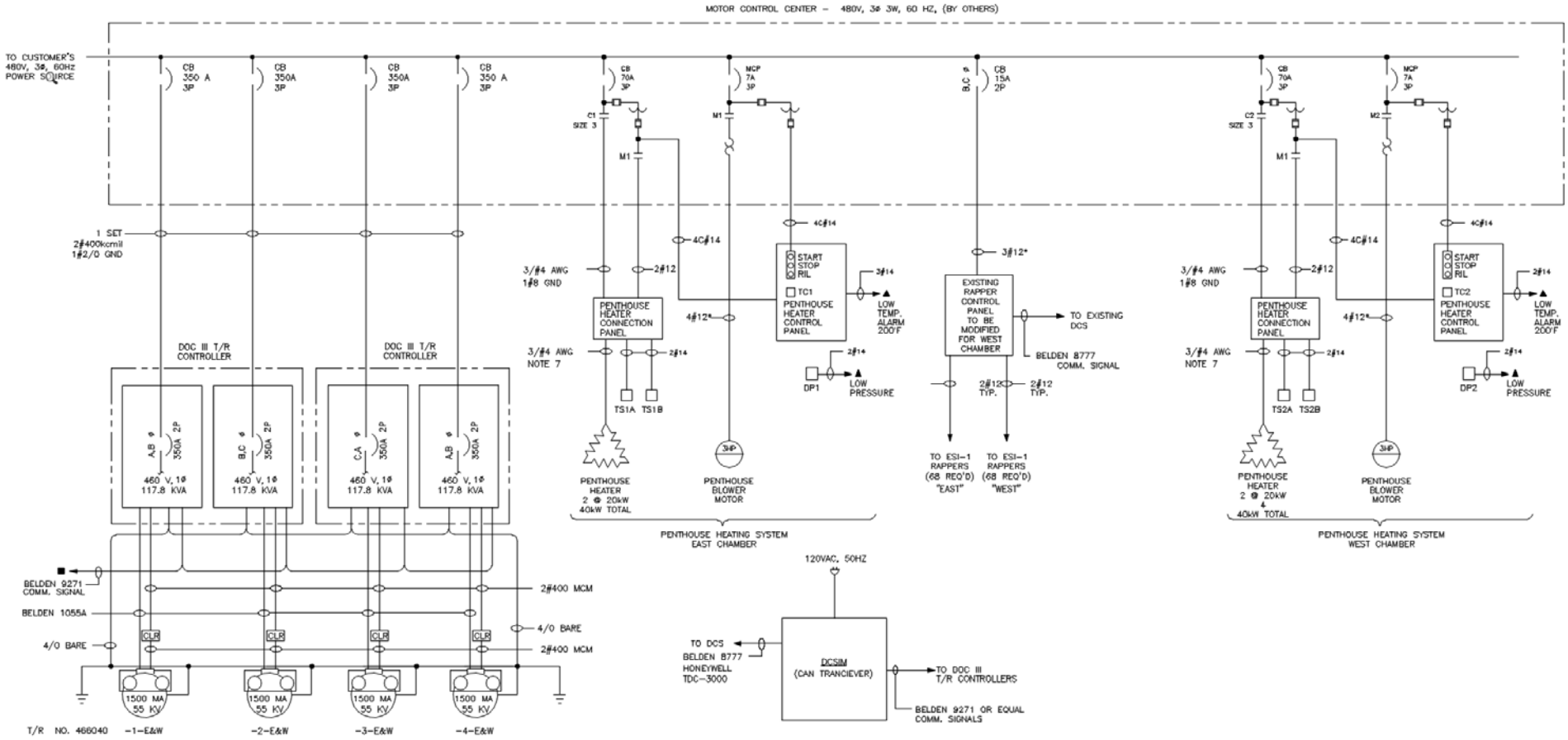
- Hoppers under the precipitator create the transition between the collected ash and the ash handling system which disposes of it
- Typically, hoppers are designed with a steep conical or pyramidal shape, to facilitate smooth flow of collected dust.
- They should be made from corrosion-resistant steel to withstand high temperatures and chemically reactive particulates.
- Hopper Heaters may be installed to prevent moisture condensation, which can cause blockages.
- Insulated walls help maintain optimal temperature conditions, preventing materials from clumping or adhering to the hopper surface.



Precipitator Roof Layout



Electrical Systems



Significant Electrical Components

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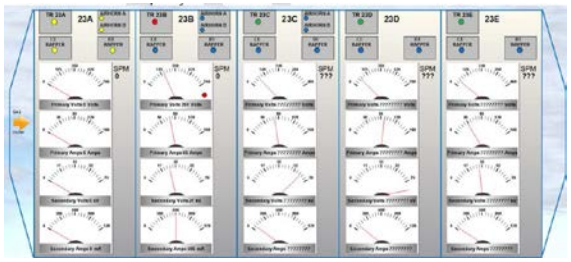
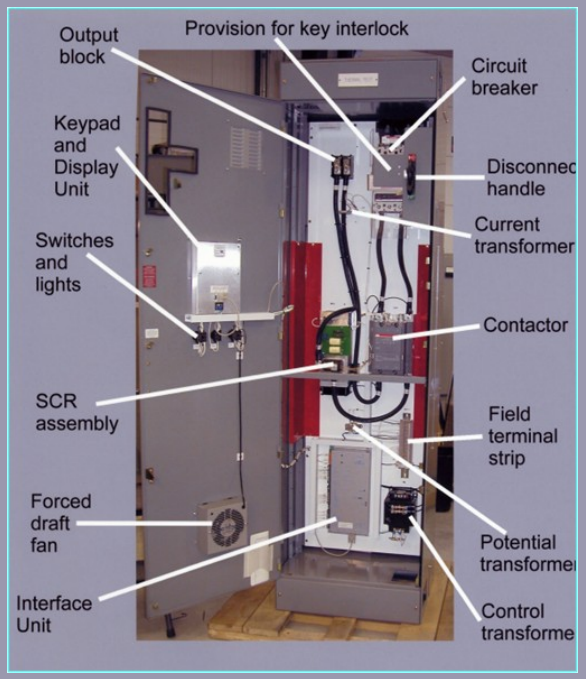
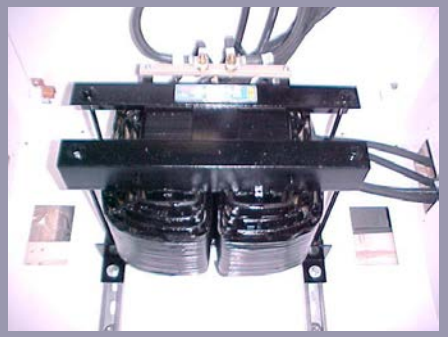
- Transformer Rectifier Set
- Transformer Rectifier Controller
- Impact or Tumble Hammer Controller
- Purge Air Heater – Blower Controller
- Hopper Heater Controller
- DCS Interface



Power Supply System

Control Cabinet

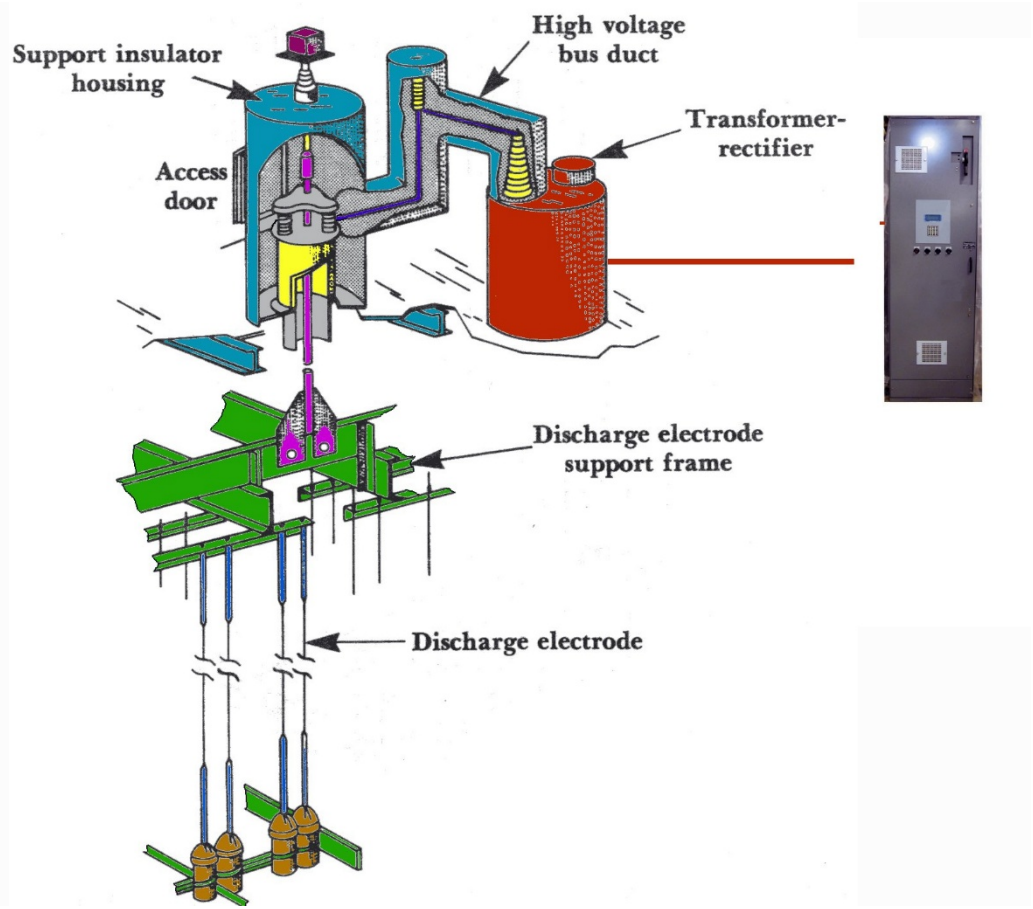




Current Limiting Reactor

Transformer Rectifier

Power Supply System



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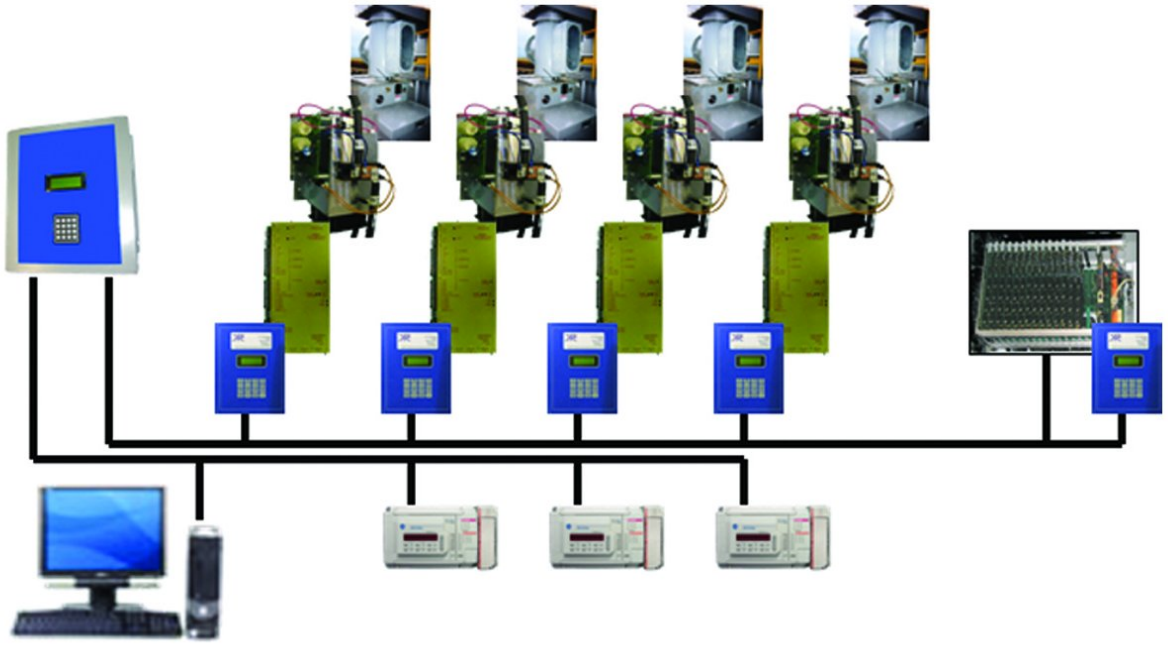
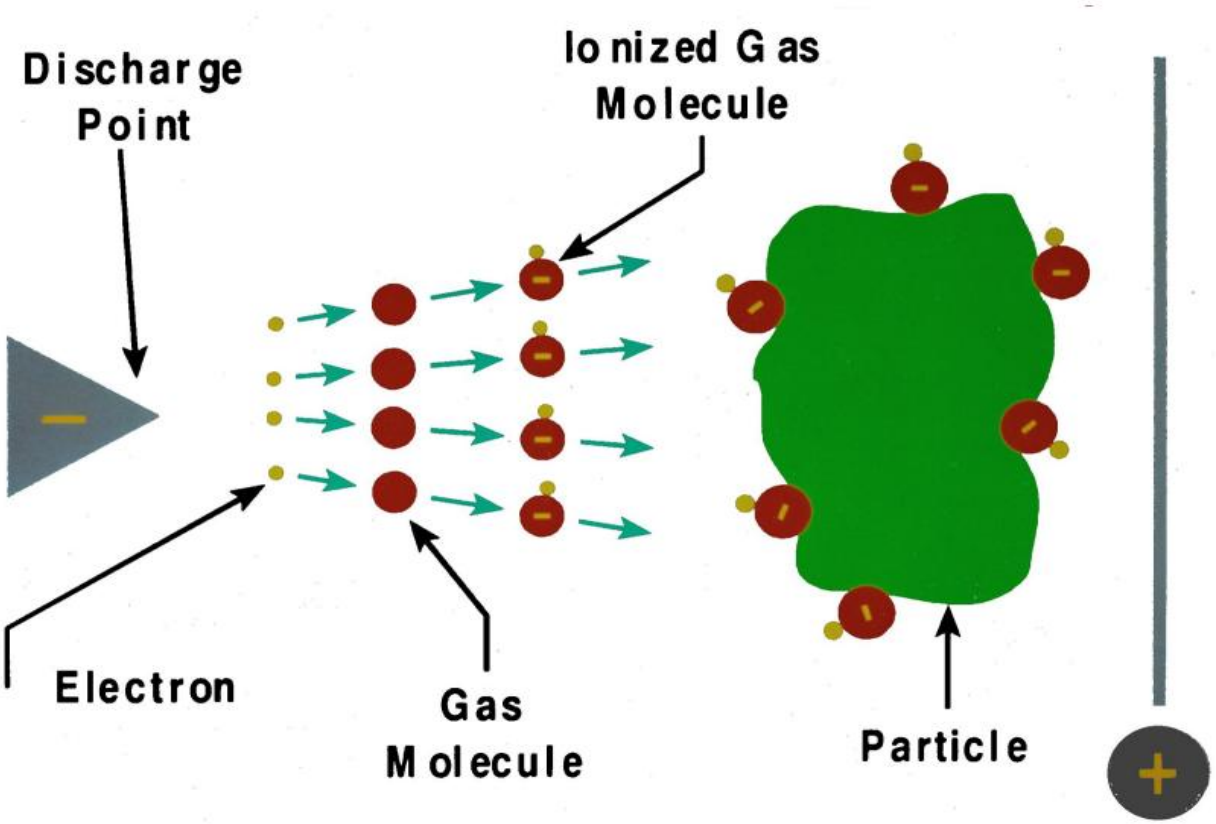
Communications System



Particle Charging



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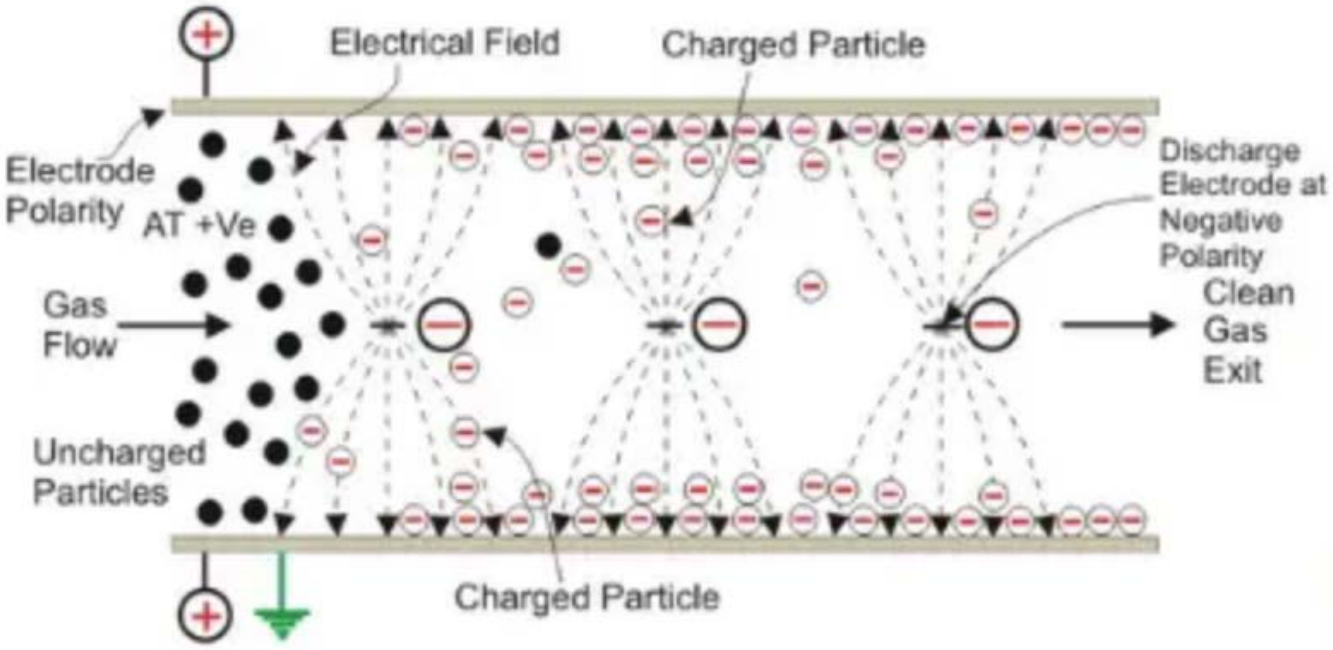
Particle Charging



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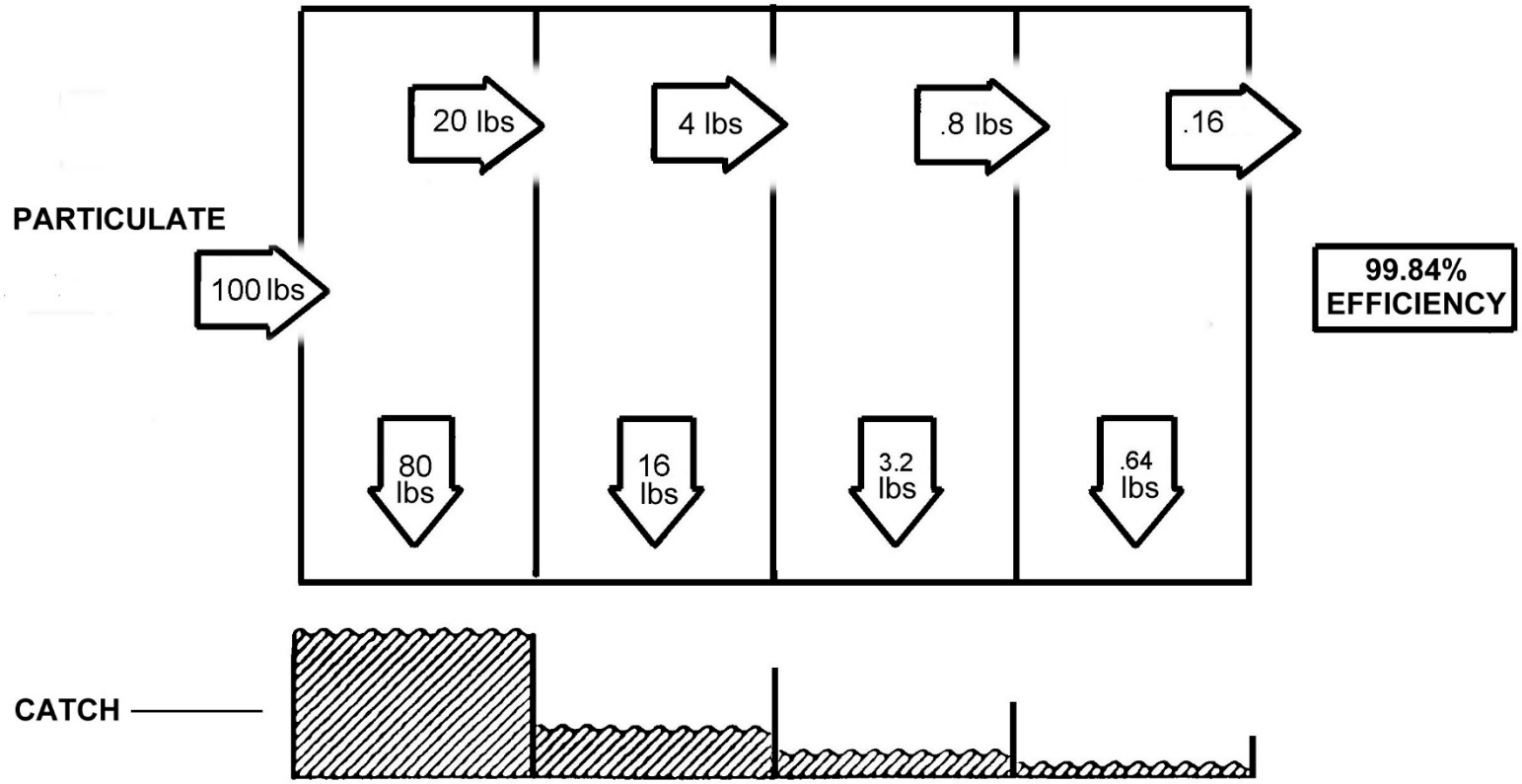
How the Collection Stack up



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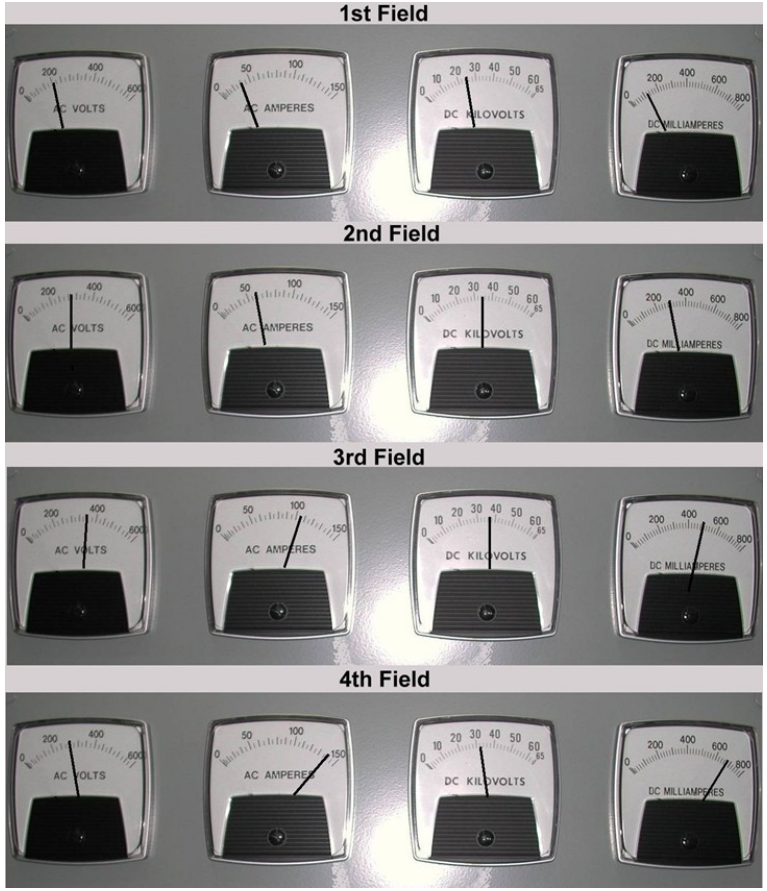
How the Electrical Fields Stack up



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The End