

# Pyrotechnic Igniters

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# How to Ignite a Bipropellant Engine?

- **Hypergolic**
  - White Fuming Nitric Acid
  - Furfuryl Alcohol
  - Simple
  - Ignition Delay
  - Open Main Valves
- **Catalyst Bed**
  - Hydrogen Peroxide
  - Simple
  - Open Main Valve
- **Pyrophoric**
  - TEA-TEB
  - Complex
  - Open Main Valve

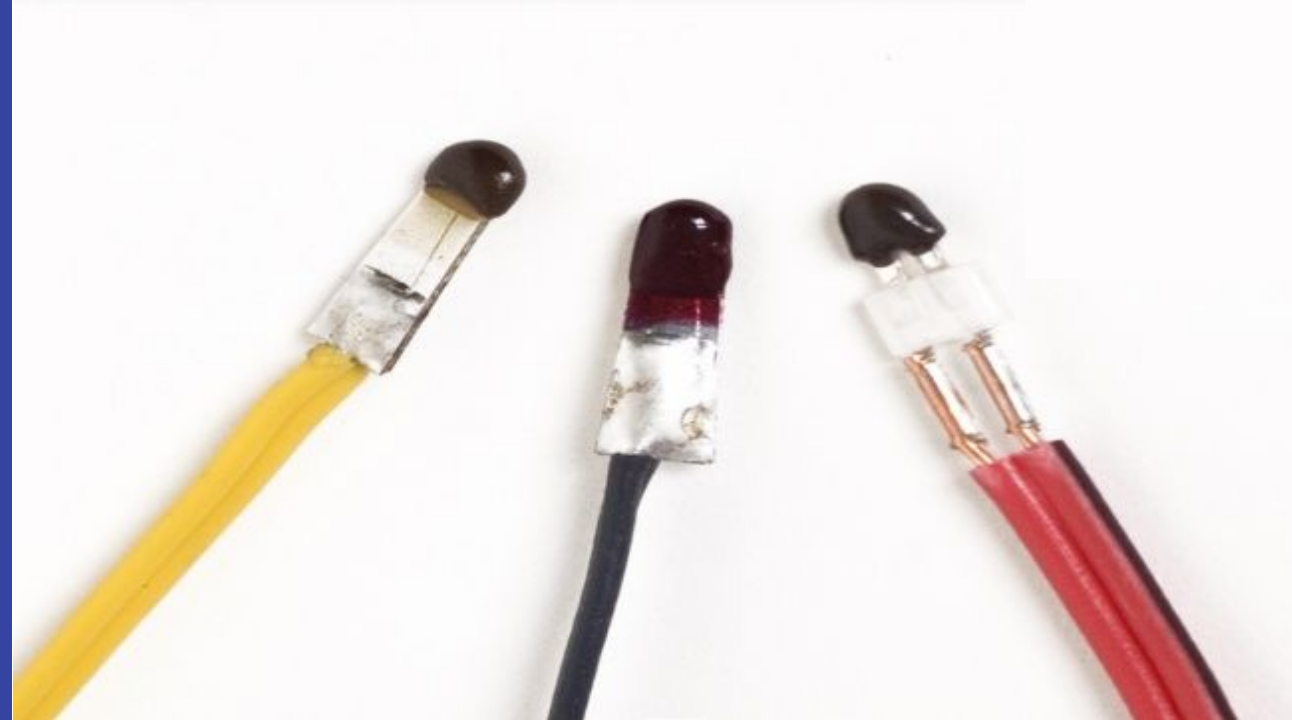
# More on How to Ignite a Bipropellant Engine?

- Sparker
  - Complex
  - May Not Be Hot Enough
- Torch
  - Complex
    - Dual Gas
    - Gas Valves
    - Sparker
  - May Get Blown Out

## Pyrotechnic Igniter

- Simple
- Hot Enough
- May Include Electric Match or Igniter

# Electric Matches Versus Igniters



- Electric Matches
  - Burn Too Fast
  - Small
  - Regulated as Explosive
- Electric Igniters
  - Burns Slower
  - Not Much Larger than a Electric Match
  - Not Regulated as Explosive

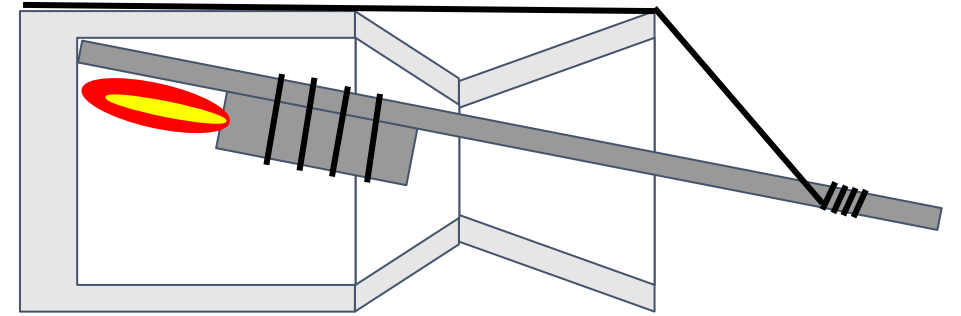
# Electric Matches and Igniters Are Not Enough

- Too small and do not supplying enough heat
- Extra pyrogen can be added
  - Coated over the electric match or igniter
  - Increases size
  - Increases heat
  - Still may not be good enough
- Add additional APCP propellant
  - Ie. C motor

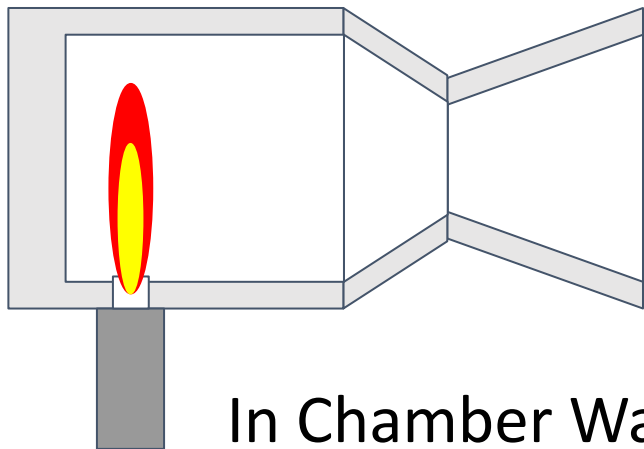
# Holding The Igniter

- Igniter holder
  - Holder
    - Vertical through the throat of the engine
    - Horizontal on side of engine
  - Distance from injector
    - Near propellant impingement point
  
- Igniter holder
  - Prevent early ejection
    - Hard start
    - Misfire
  - Stick
    - Must fit through throat of engine

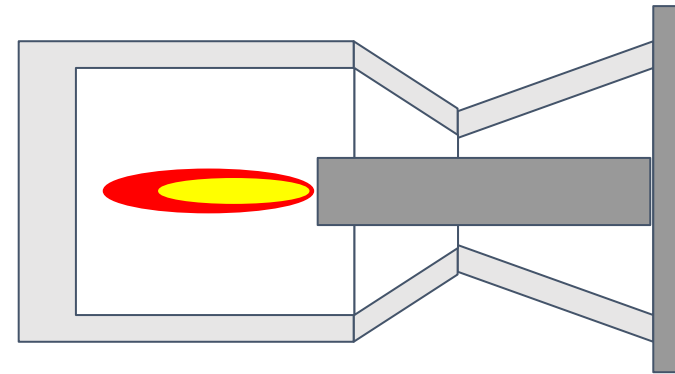
# Three Types of Holders



Stick



In Chamber Wall



In Throat

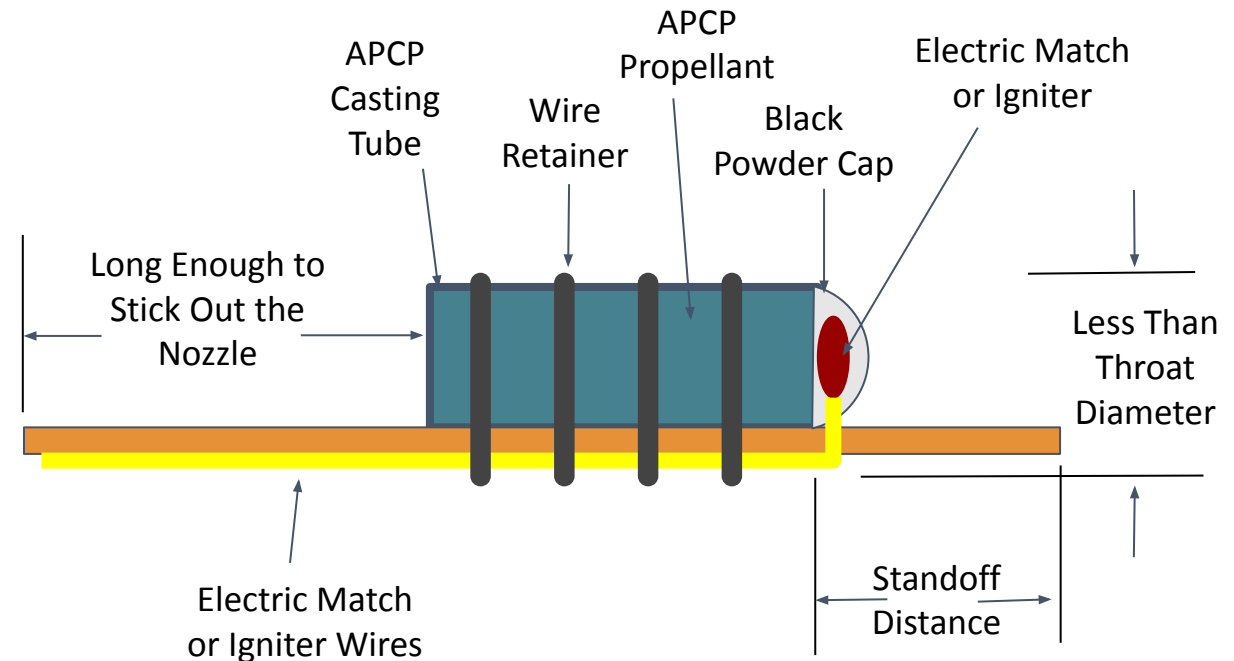
# APCP Rocket Propellant Makes A Good Igniter

- Large enough to supply enough heat
  - Intense flame
  - Not easily blown out
- Creates smoke for visual ignition verification
- Hard to start with electric match or igniter
  - Requires addition of a secondary pyrogen
    - Black powder



# APCP Stick Igniter Construction

- Less Than Throat Diameter
- Standoff Distance From The Injector
- Stick Long Enough To Stick Out The Nozzle
- Black Powder Cap To Assist The Electric Match Igniting the APCP
- Strong Retaining Wire To Prevent Ejection



# Pyrotechnic Igniter Control

- Check Continuity
- Prevent Inadvertent Ignition
  - Due to Component Failure
    - Interrupt Power
    - Interrupt Return
  - Due to Static Discharge
    - Short Power and Return
    - Ground Power and Return

# Countdown

- Allow at least 3 seconds for complete igniter ignition
- Visually verify ignition with smoke coming out of the nozzle
- Do not rely entirely on an automatic sequence

# Handling

- No smoking or open flames nearby
- Short electric match/igniter electrical wires together prior to handling
- Protect from water/moisture
- Protect from damage