

Pyrotechnic Igniters

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ACADEMIC-INDUSTRY
LIQUID ROCKET SYMPOSIUM **2023**



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

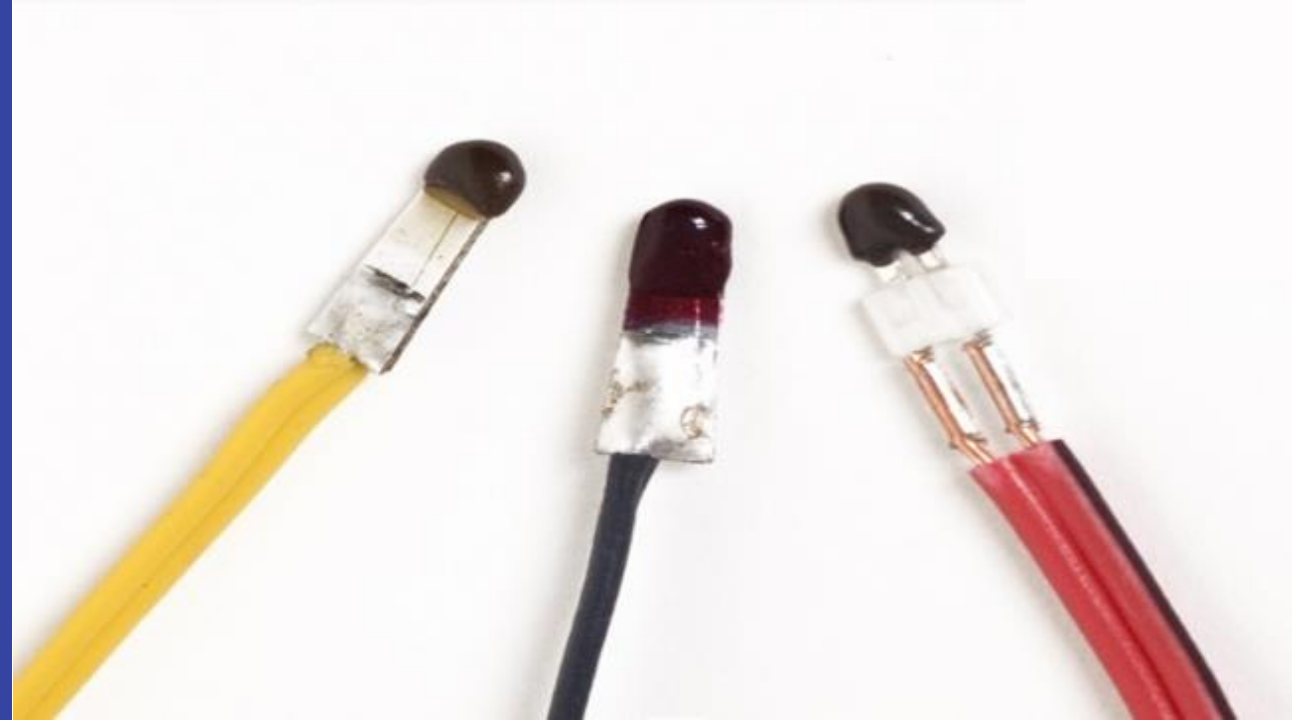
More on How to Ignite a Bipropellant Engine?

- 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

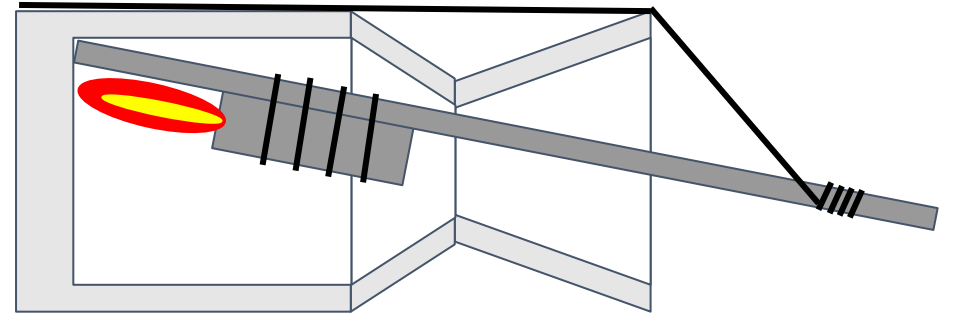
Electric Matches and Igniters Are Not Enough

- 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

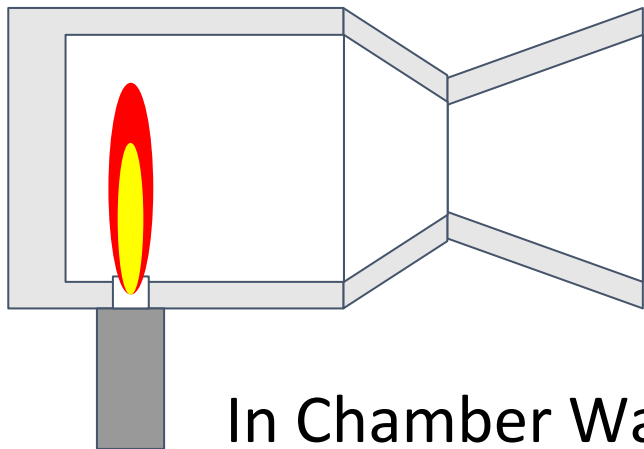
Holding The Igniter

- 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

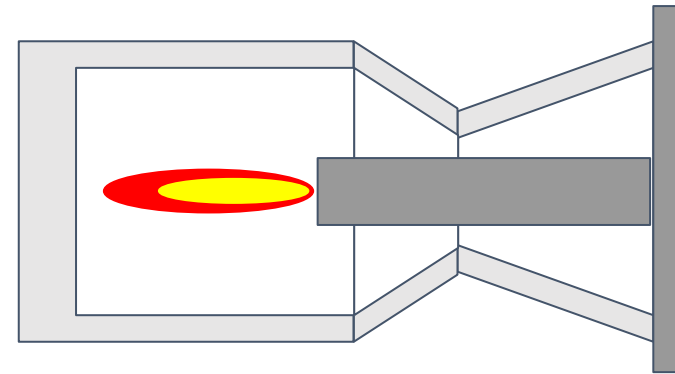
Three Types of Holders



Stick



In Chamber Wall



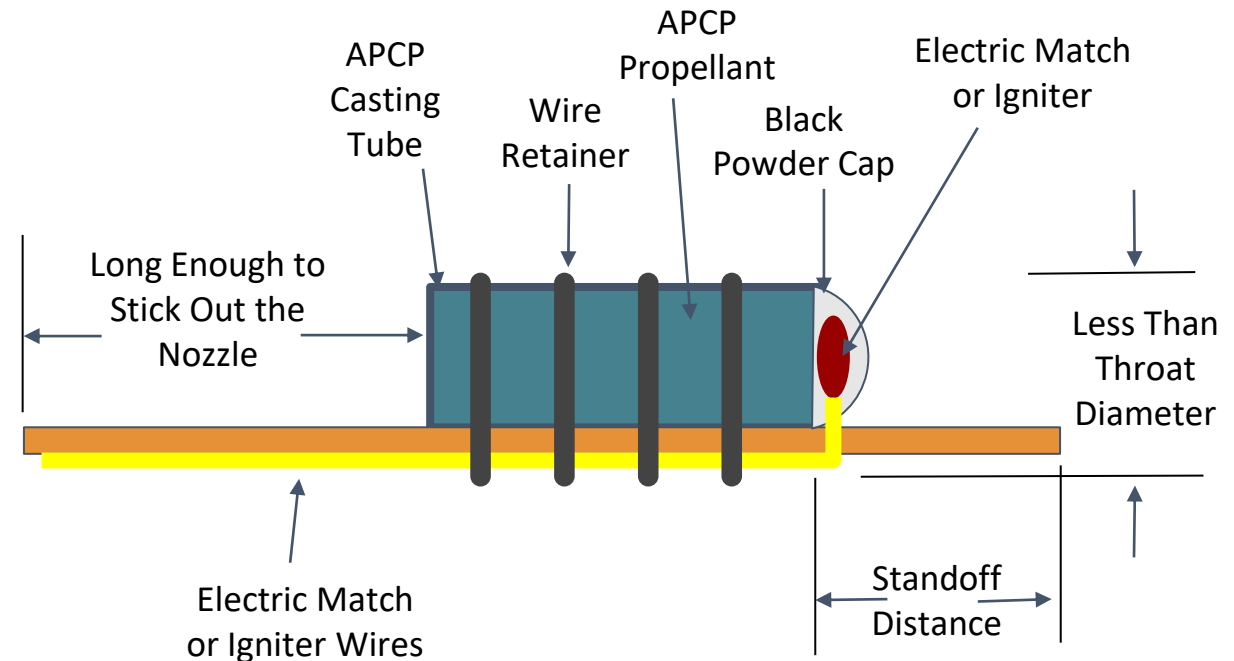
In Throat

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