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Magnetos and Spark Plugs
Class notes

Function of Flyweights
• Flyweights in motion centrifugally hold in the contact lobes
• Contact lobes are prevented from striking the pins
• Disables the impulse coupling
• Allows magneto to operate normally

Auxiliary Starting system,
using separate booster coil
• High tension current is distributed through special rotor
• Rotor directs spark to the cylinder just BEHIND in the firing order
• Example: firing order is 1,3,5,7,9
• If #5 is due to be fired normally, this rotor directs spark to #3

Spark Plug Reach
• Short reach differs from long in the threaded end installed in the engine head
• Short reach features ½" of thread
• Long reach features 13/16"
• No other differences.

Spark Plug installation
• Incorrect tools such as pliers, crescent wrenches, side cutters cause damage
• Internal damage is not readily visible
• Invisible internal damage will eventually cause failure of the plug
• May lead to failure of the engine

Spark Plug installation
• Only use approved lubricants
• Use spark plug anti-seize compound
• Champion manufacturers the only approved brand available
• Emergency alternate: engine lube oil

Spark plug gaskets
• Purpose: seal plug to cylinder head
• Lack of a seal will allow gases to escape
– Affects engine performance
– Generates heat and hot spots
– Causes pre-ignition and/or detonation
– Can cause engine fire
– Used gaskets can be reconditioned (annealed) by heating to bright red color and cooling slowly.

Spark Plug Heat Ranges
• Simply defined by the distance the heat must travel to escape the barrel.
• Long path = hotter plug

Champion Spark Plugs
• Check out championaerospace.com

Spark Plug installation torque
• Follow manufacturer's specs
• Overtorquing will cause damage to center core
• Insulator damage may result
• Extreme cases will strip threads in plug or cylinder head.

Spark Plug handling
• You drop it, you own it.
• Discard any spark plug that has been dropped; internal invisible damage may have occurred
• At $40 a plug, it gets expensive

Spark Plug installation
• Do not install spark plugs with improper reach characteristics
• Long reach plugs installed in a short reach engine may contact piston crown causing damage to both parts
• Short reach plugs installed in an engine requiring long reach plugs will affect performance, temperatures, and cause carbon deposits on open threads.

Engine Magneto Booster system
• Turned on by hand in the cockpit
• Or may be automatically powered through the starter switch (battery-powered transformer type)

Booster Coil system
• Uses a separate magneto, or
• A separate battery operated step-up transformer

Induction vibrator
• Excites the coil of the magneto
• Induces current into the secondary winding
• Uses pulsating DC
• Allows multiple sparks as long as the breaker points stay open

Magneto troubleshooting
• Use an ohmmeter (multimeter, or lamp & battery)
• Connect to either "L," "R," or "Both" contacts of the ignition switch
• Ensure switch is in OFF position
• Ohmmeter should show continuity to ground
• If an "Open Circuit" exists between magneto and ignition switch, there cannot be a ground. Circuit remains open. Magneto remains "Live"

• Dangerous condition
• Always ground the “P” lead when working around magnetos
• Ignition switch grounds the Primary circuit of the magneto, not the secondary.

Magneto Troubleshooting
• Impulse couplings require coil springs to wind up the magneto for hotter start spark
• Broken or disconnected springs do not affect regular operation of the magneto, however
• They do make starting the engine very difficult (no retarded spark, weak spark)

Normal Appearance 


Worn Out


Mechanical Damage


Detonation


Overheated


Oil Deposits


Sustained Pre-Ignition


Carbon Deposits

Spark Plug Gap
• Too wide a gap makes for hard starting engine
• Too narrow a gap creates slow burning flame front

Spark Plug
• Definition: a device used to convert electrical energy produced by the magneto into heat energy required to ignite the fuel/air mixture

Spark Plug major parts
• Electrodes
– Massive, or
– Fine wire
• Ceramic Insulator
• Metal Shell

Spark Plug types
• Shielded (most common)
• Unshielded (nordo)

Spark Plug Terminal Ends
• 5/8” – 24 tpi (general useage)
• ¾” – 20 tpi (high altitude, flashover resistant)

Spark Plug Maintenance
• Always use the correct type of spark plug
• Always use the correct tools
• Do not use pliers, crescent wrenches, etc.

• Always torque to Mfr's specifications
• Do not install without anti-seize compound
• Do not bend or damage terminal elbow
• Check all terminal ends for cleanliness
• Use proper gauge for checking gap
• Use only wire gauges for gapping
• Threads can be stripped by overtorquing

More Spark Plug Maintenance
• Do not use carbon tetrachloride for cleaning: leaves a film which will conduct current
• Use only a vapor degreaser, or Stoddard solvent, or gasoline.
• Always use a new or annealed gasket, and only one per plug
• For blast cleaning, only use aluminum oxide abrasives
• Electrodes can be worn up to ½ thickness

Spark Plug Fouling
• A spark plug is considered fouled when the spark grounds without jumping the electrodes

Special Considerations for Fine Wire Spark Plugs
• Do NOT bang a fine wire spark plug on the workbench
• Use a special tool to set the gap
• Testing requires high voltage

Spark Plug cleaning
• Abrasive blast:
– Rubber adapter… don't wobble more than 20°
– Air blast clean thereafter
– 3 – 10 seconds per blast

Further Spark Plug Maintenance
• Plugs can be reconditioned (cleaned, regapped)
• Plugs taken out should be re-installed in the same cylinder, UNLESS rotating the order
• Always use a plug cradle
• Check for blow-by after installing

Spark Plug Visual Inspection
• Electrode Gap
• Electrode condition (min 1/2 dia. Thickness)
• Insulator for cracks or chips
• Lead fouling
• Centre electrode burning
• Damaged threads
• Cracked metal shield
• Correct reach of plug

Factors in governing Spark Plug heat range
• Area of plug exposed to the flame in the cylinder
• Area of plug exposed to cool air outside the cylinder
• Rate of heat conductivity of plug
• Always the correct plug part number
• Keep constant check of temperatures and plug conditions
• Discuss problems with engine & plug representatives

The Murphy Effect
• Do NOT attempt to take a spark plug apart!

Spark Plug identification
• RE 38 P
– R = Resistor type
– E = Shielded, 5/8 – 24 tpi
– 38 = medium heat range

Spark Plug identification
• SR 83 P
– S = Short reach
– R = Resistor
– 8 = 18 mm
– 3 = medium heat range
– P = platinum

Spark plug identification
• Resistor type: “R”
– No “R”, no resistor
• Shielding
– No letter, no shielding

Spark Plug heat ranges
• 26 – 50 cold
• 50 – 76 hot
• 76 – 99 special application

Spark Plug Insulator
• Used to be made of Mica
• Now made of ceramics of diamond hardness
• Terminal contact: screwed into insulator
– Ensures perfect contact with the cigarette tip

Spark plug resistor
• Prevents points from burning and corroding when used in conjunction with leads (harness) having shielding.
• Capacitance in harness can cause high current above that required for spark

Spark plug Electrodes

• Inner electrode: copper core with nickel plating
• Outer electrodes:
– Massive (2, 3 or 4 electrodes) made of nickel
– General aviation purposes. Cheaper
– Fine Wire: 2 electrodes
• Better plug
• Does not corrode or burn as much
• More expensive

Spark Plugs, additional notes
• What happens to the magneto when the plug fouls? Nothing.
• "Hot" plugs are achieved by manufacturing a longer insulator within the barrel
• Using cold spark plugs in a high-compression engine will probably function normally
• Spark occur at the plug when the primary circuit is broken
• Ignition actually takes place before the piston reaches TDC on the compression stroke

Spark Plugs, additional notes
• There is no difference in the heat range characteristics related to plug reach
• Plugs are designed so that the insulator tip is reasonably short to hasten the rate of heat transfer from the tip through the spark plug shell to the cylinder head
• A defective plug affects sparking at all engine speeds
• Center core and insulator damage may result from overtorquing a spark plug
• The electrical circuit from the spark plug back to the magneto is completed by grounding through the engine structure to the magneto

And more
• The one part of the plug likely to be damaged during removal of a shielded plug is the core insulator
• Testing the entire engine harness reveals leakage in a majority of leads…. The probable cause may be a deteriorated distributor block
• Improper gapping procedures will lead to ceramic insulator damage (fracture, breaks)
• The rate of heat transfer of the engine seat gasket will affect the spark plug operating temp
• When gapping massive-electrode plugs, do not use a wire gauge between the center electrode and ground electrode during gapping procedures

yet?
• Switching between banks of spark plugs shows a fast drop between selections. This is likely due to faulty or fouled plugs
• Cracked insulator tips are cause for rejection of the spark plug
• Shielding on spark plug wires is used to prevent interference with radio reception. It does so by grounding all radio waves emanating from the magneto and high tension leads

You made it
End of Notes

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