Theory of Operation

TOP 205 STIHL M-Tronic™

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- The idea with M-Tronic™ is to take a venturi style carburetor one more step towards providing a hand held machine optimum performance under varying conditions:
  - Simple starting procedure
  - Running sensitivity to air filter condition
  - Automatic adjustment to fuel quality variations
  - Instant reaction to changing load
  - Automatic altitude adjustment for best running performance

The STIHL M-Tronic™ is an innovative microprocessor-controlled engine management system and is found on most professional chain saw models and some forestry clearing saws.

This revolutionary microprocessor-controlled technology automatically adapts to environmental factors, such as fuel quality, engine temperature, altitude and a dirty air filter, then adjusts the fuel/air mixture and engine speed, optimizing performance in a wide range of conditions.

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- Two-magnet flywheel supplies the system energy and no additional battery or power source is necessary
- Control unit with microprocessor measures crankshaft RPM and determines if engine is accelerating or decelerating based on rate of change

The flywheel has two magnets, one is oriented as North/South and the other is reversed, South/North. The magnetism created is used to fire the spark plug as well as the source of power to operate the fuel management system. During starting and while the engine is running, the control unit is powered via the second pair of poles.

The quartz clock in the microprocessor is constantly monitoring the electric pulses from the flywheel to calculate RPM and know if the engine is accelerating or decelerating.

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- Control Unit:
  - Controls the fuel mixture for all operating conditions electronically
  - Electronic control of ignition timing at all engine speeds
  - Takes engine temperature into account when metering fuel
  - Optimum engine power at all times – even in varying conditions

Since the module is controlling the spark as well as the fuel delivery, it is known as the control unit.

The engine speed can be influenced instantly by adjusting the ignition timing. Changing the fuel flow only influences the engine speed after 5 to 10 revolutions of the crankshaft. For this reason, to establish steady idling, the ignition timing is adjusted first and then the fuel flow.

If the control unit detects that the engine is being accelerated, the ignition timing is advanced and the fuel flow is increased, this gives optimal acceleration.

An adjustment process or what is known as the “control process” will be initiated only if the chain saw is operated for approximately 2 seconds under uniform conditions, meaning under a constant load between 8,000 rpm and 11,200 rpm. The solenoid valve closes for approximately 0.1 seconds – resulting in a leaner fuel-air mixture. The resulting engine pattern is analyzed by the microprocessor.

Engine speed increases – mix was too rich, fuel flow remains reduced.

Engine speed decreases – mix was too lean before the solenoid valve was closed, fuel flow is increased.

Engine speed does not change – the current setting is optimal and will be maintained.

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- Simplified starting:
  - **O** is off
  - **I** is run / warm start
  - ▲ is cold start

- In the ▲ position the rear butterfly and micro switch are closed - control unit is in cold start mode
- Engine will continue to run in this position after starting

The starting procedure is simplified with fewer steps involved. Some models are equipped with a stop switch function that allows the Master Control Lever™ to spring back to the normal run position when it is released. This ensures that the ignition is on and simplifies the next start.

When the Master Control Lever™ is placed in the ▲cold start position the microprocessor detects that the micro switch has been actuated and the choke shutter is closed and computes the necessary amount of fuel and the ignition timing for the start. During starting the fuel-air mixture is highly enriched. After the initial combustion, the quantity of fuel is reduced. The engine does not stall out because the fuel-air mixture is too rich; it keeps running and can be accelerated immediately. After the throttle trigger is actuated, the choke shutter and micro switch open and the Master Control Lever™ jumps to the operating or run position.

For a warm restart, simply place the Master Control Lever™ in the run position, unless the engine ran out of fuel. In that case use the ▲cold start position for restarting after the tank has been filled.

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- The normally open digital solenoid valve on the carb is operated by the control unit and the dwell time it is open or closed determines the amount of fuel that flows
- A fault in the wiring harness or solenoid will always result in a rich fuel situation to prevent engine damage

Instead of having mixture screws on the carburetor to meter the fuel delivery, a digitally controlled solenoid valve delivers the fuel needed for optimal performance. The valve is normally open and closes when it is powered by the control unit.

The valve can be replaced if necessary. It should be carefully removed for cleaning the carburetor. The solenoid should not be cleaned with compressed air, harsh chemicals or an ultra-sonic parts washer.

Flush it with non-flammable brake clean if necessary.

Conventional Carb Fuel Flow

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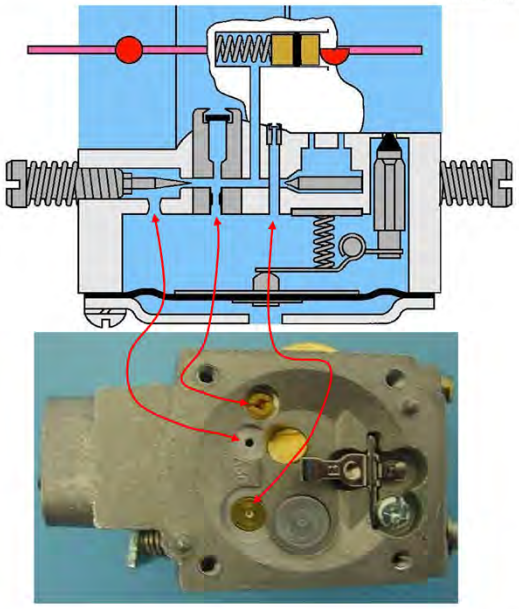
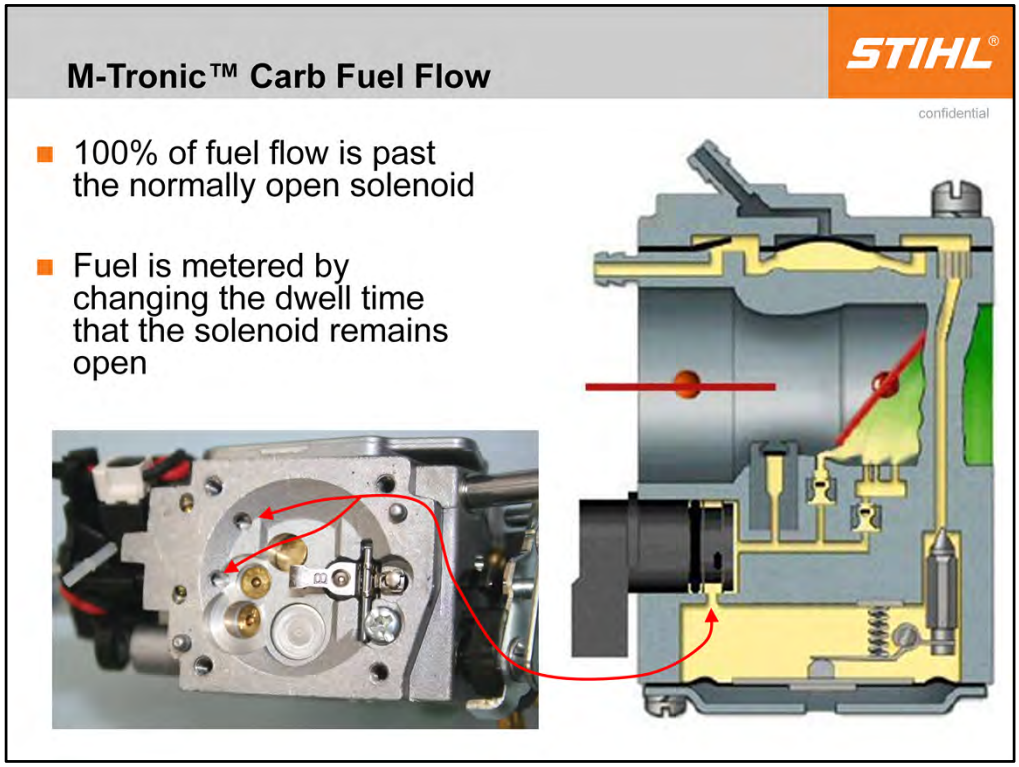
- At idle fuel flows past the L mixture needle
- At part throttle fuel flows past the L mixture screw and the part load jet
- At WOT fuel flows past the L and H mixture screw, the part load jet and the bypass jet



In a conventional carburetor all fuel flow is adjusted and metered by mixture screws. The L screw adjusts fuel flow at idle speed, and the H screw adjusts fuel flow for WOT operation. Typically a pro series saw will also have an accelerator pump to richen the mixture when the throttle is snapped open and the carburetor may also have a part load jet to add fuel as the engine accelerates. Most current carburetors also use a bypass jet that supplies approximately 80% of the fuel needed for WOT running. All of these fuel feeds must be balanced and tuned to provide proper running, yet they are all static adjustments that can't compensate for altitude, fuel quality or engine load.



In an M-Tronic™ carburetor 100% of the fuel leaving the metering chamber flows into and is metered by the dwell time of the opening and closing solenoid valve.

One way to think of this is that there is now a means to adjust the carburetor every 2 seconds for all operating conditions the engine might encounter. It is done automatically and constantly and is seamless and un-noticeable to the operator.