Carburetors

4-9-2010

Original Equipment -- When your Model "H" tractor left the factory, it was equipped with DLTX-26 from H1000 thru H26999. Beginning with H27000, DLTX-46 was installed. The main difference is in the choke assembly, the "-46" having a choke lever that could be controlled remotely by a small rod from the operator's panel to accommodate E-start tractors; E-start option offering at H27000. Figure 800 illustrates both carburetors, each with the choke in engine-operating position. DLTX-46 can successfully be used on all model H tractors, and is listed as the genuine JD replacement for all "H" tractors.

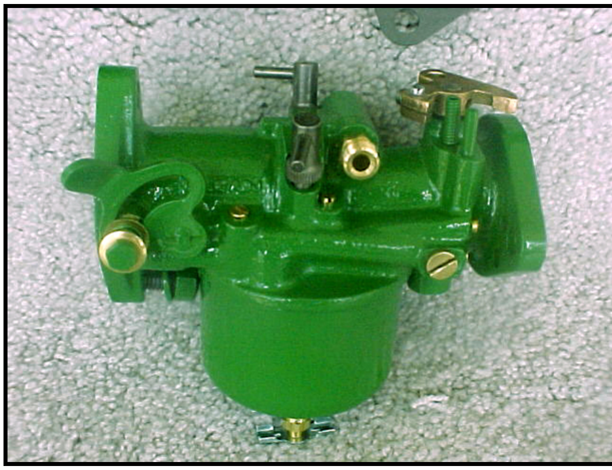

Figure 801. DLTX26

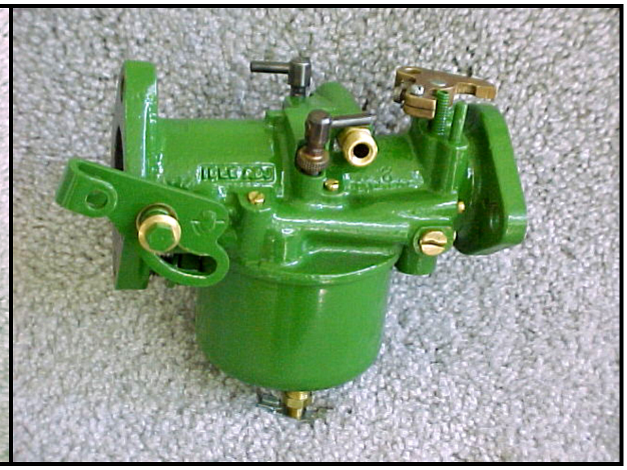

Figure 802. DLTX46

Universal Replacements -- Toward the end of the 1960's, Marvel Schebler/Zenith collapsed all their DLTX series carburetors for John Deere into three carburetors - the DLTX107U, designed to replace the small-bore carburetors (for the B and H), the DLTX108U for the large-bore carburetors (for the A, D and G), and a DLTX109U duplex carburetor for all the numbered series tractors. And so, locating a Model H tractor with a DLTX107U is entirely possible, and would be a welcome find indeed! (Credit: Duane Larson).

Theory of Operation

What is a carburetor? What does a carburetor do?

By definition a carburetor is a device for mixing (or charging) air and gas; specifically, a device in which air is mixed with gasoline spray to supply a vaporized, explosive mixture for an internal combustion engine. The mix is no longer plain, raw gasoline, but a more volatile gaseous compound. (Webster's Collegiate Dictionary).

About Your John Deere "H" Carburetor

Most all two-cylinder John Deere tractor carburetor bodies are made of cast iron, and this is true for the "H" tractor. They have moving parts that may have become worn, orifices clogged with old fuel, and the float may have been abused and/or may have developed a leak. The internal fuel and air passages once coated with a rust preventative, now are no longer being so protected. Thus, aside from wear to moving parts, the main body is prone to become filled with rust, clogging those air and fuel passages, and you cannot "boil" rust out.

If you started out with a running tractor, you are ahead of the game because you know the carburetor is basically functional, and you can judge its performance. While I hesitate to ever recommend a custom rebuild kit for the DLTX carburetor, such a solution may indeed be appropriate for running tractors. In general, however, I prefer to let the carburetor "tell me" what is needed. And this information is evident only after disassembly and a really close inspection of the operating parts. As an example, if with the naked eye you are able to see wear, or deformation (during your close inspection) of either of the two operating needle valve tapers (Idle or Load), it's time to renew such a needle! Another area to pay close attention to is how much "play" you find in the throttle shaft versus its two bushings. This shaft and its bushings see a lot of action, moving each and every time the governor drives the throttle. The top bushing is prone to faster wear because it is closest to the acting forces. The throttle shaft fit into its bushings needs to be very close to tight, but not a "binding" tight fit; a machinist's "snug fit." Such a close-fit is not nearly as critical with the choke shaft as we are dealing with air only on the choke side of the carburetor's venturi, and leakage here will have no effect on fuel-air mix ratios. (Note: *Venturi* is the narrowed place in the carburetor's "throat" or "barrel").

On the other hand, starting with a tractor that you haven't heard run, that may not have run for years. and is not now running, puts you at a disadvantage insofar as the carburetor is concerned. You have no clue. You are beginning with what must be assumed to be a dysfunctional carburetor. You clean and rebuild, replacing unserviceable parts as found. This approach assumes plenty of wear, and that any passageway that could be rusted shut *IS* rusted shut; and you proceed from this point forward.

The Basic Systems of the Natural-Draft Carburetor

1. Idling System

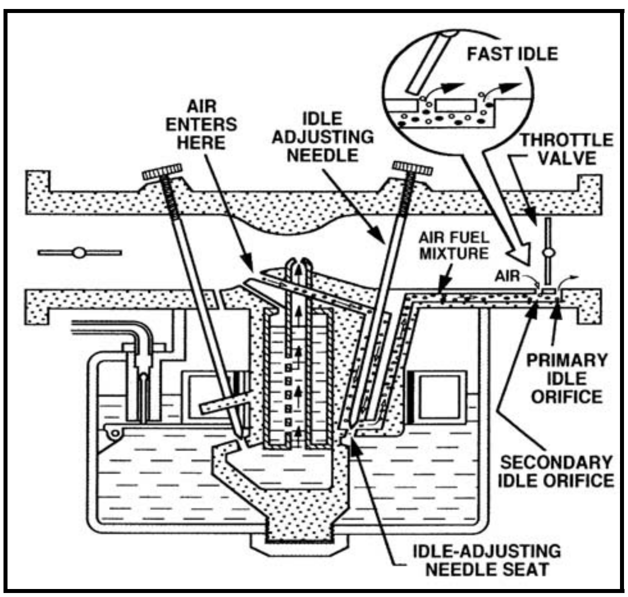

Figure 803 - Idling System Diagram

When the throttle valve is closed, the idling system supplies just enough fuel-air mixture to keep the engine running (slow idle). The closed throttle reduces airflow through the venturi to a level that cannot overcome the resistance to flow of load fuel up through the fuel nozzle, but also means that a fairly significant vacuum occurs on the engine side of the throttle valve. This manifold vacuum is sufficient to pull the fuel-air mixture through a series of small channels and openings that by-pass the throttle valve. Air enters through a small passage in the carburetor body at the venturi ridge (not thru the venturi) and passes across an idle-adjusting needle seat. At this point, the air picks up fuel and the fuel-air mixture is delivered to the engine through a series of drilled passageways leading to an opening (the primary idle orifice) on the engine side of the closed throttle valve. A secondary idle orifice feeds air into the fuel-air stream, thinning down the fuel-air mixture to satisfy the slower idle requirements. The amount of fuel entering the air stream can be regulated by the idle-adjusting needle.

The manifold vacuum on the engine side of the closed throttle valve provides the needed pressure differential across the throttle valve to cause fuel-air mix to flow in that direction. The amount of fuel is determined by adjustment of the Idle needle valve. Observe that air flow, an engine function, is determined by the condition of the valves or piston rings, or the engine's ability to draw the air-fuel mix.

The result is an entirely separate carburetor circuit that by itself operates to feed the engine when the throttle valve is closed.

As the throttle is opened up slightly from the fully closed position, the side of the rotating throttle plate opening toward the venturi, exposes the secondary idle orifice to manifold vacuum allowing greater flow of a leaner fuel-air idle mix. And at the same time, also providing a transition to metered fuel flow through the regular open throttle (load) circuit. As the throttle is progressively opened, the manifold vacuum reduces since there is less restriction on airflow, reducing the flow through the idle circuit. This is where the venturi shape of the carburetor throat comes into play, due to the Bernoulli effect (i.e. as the velocity of a gas increases through a fixed orifice, its pressure falls). As the throttle valve closes when load is relaxed, the airflow through the venturi drops until the reduced pressure is insufficient to maintain load fuel flow and the idle circuit takes over again as described above.

2. Load System

This system meters fuel, and delivers the proper fuel-air mixture to the engine in all governed ranges of speed and load above idling. The amount of fuel entering the nozzle is regulated by a load-adjusting needle. A carburetor basically consists of an open pipe, the carburetor's "throat" or "barrel", through which air passes into the inlet manifold of the engine. The pipe is in the form of a venturi, that is, it narrows in cross-section and then widens again, causing airflow to increase in speed through the narrowest part. This is where the Bernoulli principle comes to life; i.e., that moving air has lower pressure than still air, and that the faster the movement of the air, the lower the pressure. Generally speaking, the throttle or accelerator does not control the flow of liquid fuel. Instead, it controls the amount of air that enters the carburetor. Faster flow of air and more air entering the carburetor draws more fuel into the carburetor due to the partial vacuum that is created.

The throttle valve is linked to the governor that is designed to regulate engine speed by sensing small changes in engine speed (flying weight system); opening the throttle valve as speed slows, and closing the valve as speed rises, and reaches its regulated rate.

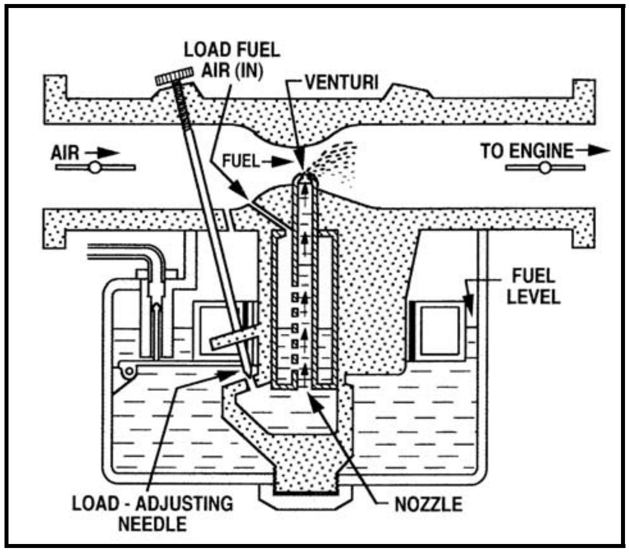

Figure 804 - Load System Diagram

Fuel is introduced into the air stream through the fuel nozzle positioned at the narrowest part of the venturi. The rate of fuel flow in response to a particular pressure drop in the venturi is a function of two variables, one is the load-adjusting needle valve (the equivalent to a fixed fuel jet in an automotive carb), and the other is fuel held in reserve in the accelerating well which surrounds the fuel nozzle.

3. Accelerating System

Whenever the throttle is opened quickly to give extra power for a sudden load, an extra amount of fuel is required for a momentarily richer fuel-air mixture. The inertia of liquid fuel being greater than that of air means that when the throttle is suddenly opened in reaction to a sudden load, airflow would increase ahead of fuel flow. Were this to occur, this temporary "lean" condition would cause the engine to "hesitate" or "bog down" under acceleration. In automotive carburetors, this sudden demand for a rich fuel-air mix is satisfied using a small plunger-type accelerator pump to inject extra fuel, fuel above the metered amount to cover this lean period. In this, and in most carburetors used by Deere, an accelerating well provides the extra fuel.

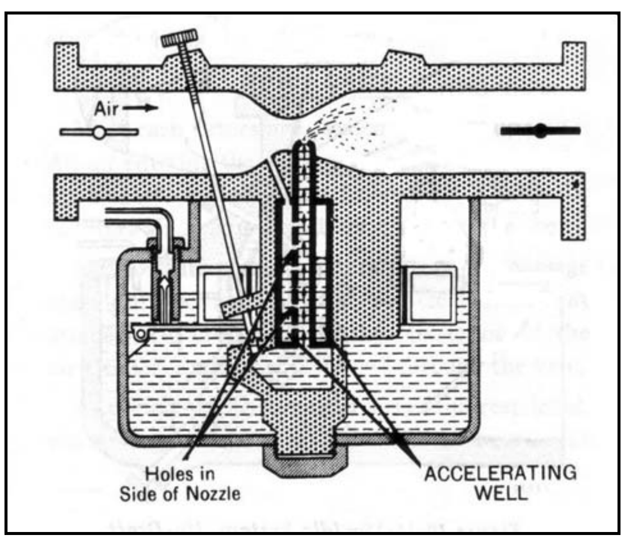

Figure 805 - Accelerating System Diagram

When the engine is idling, fuel rises inside the load nozzle and passes through holes in the side (wall) of the nozzle into the chamber, or well, surrounding the nozzle where it (the fuel) accumulates. When the throttle valve is suddenly opened, the fuel stored in the accelerating well gushes through the holes in the side of the nozzle without being metered by the adjusting needle and combines with the normal flow in the nozzle. The two quantities of fuel enter the air stream, making a much richer air-fuel mixture to satisfy the sudden requirement for more power. As the fuel supply in the accelerating well diminishes, the holes uncovered by the fuel leaving become air bleeds, satisfied by the "Load Fuel Air (in)" passage at the top of the accelerating well. After the accelerating well is drained, it remains empty until the fuel consumed by the engine is less than the fuel flowing into the accelerating well (through the LOAD-adjusting needle), at which time it refills with this excess fuel. This occurs when the throttle returns to a 1/4 load or to fast-idle position.

4. Economizer System - A System of Pressure Differentials (Figures 806 & 807)

The economizer system retards the flow of fuel to the engine at part-throttle speeds, when full capacity of the fuel nozzle is not required. Fuel is delivered out of the main nozzle opening by a difference in air pressure at the top of the nozzle and the pressure on the fuel in the bowl. To regulate this pressure in the part-load range, a passageway is drilled from the air cleaner side of the carburetor body, through a trap construction toward the center of the body and continuing to the manifold side of the carburetor. This passage way has an opening into the bowl near the trap section (bowl vent).

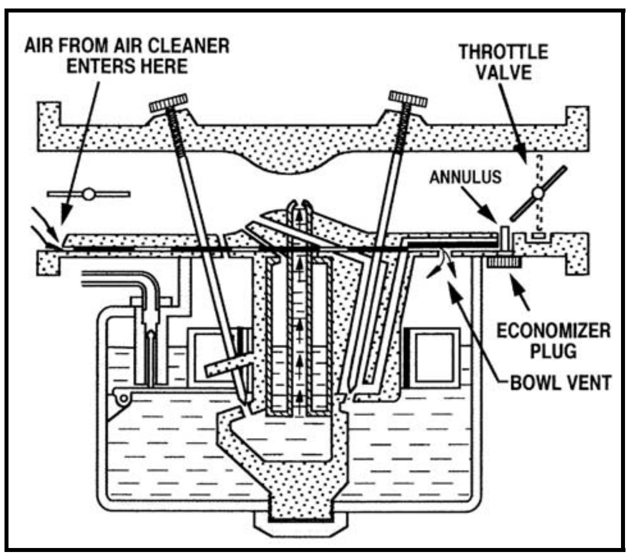

Figure 806 - Economizer System Diagram

Located in this drilled passageway (toward the engine manifold end), there is a calibrated economizer plug mounted into an also-calibrated annulus or channel. These work together to regulate the exact pressure desired on the fuel in the bowl, so as to provide maximum economy throughout the entire operating range. When the throttle butterfly passes the opening in the passageway, the pressure is reduced. This reduction in pressure is carried back through the pressure-regulating opening, enabling the carburetor to automatically adjust the pressure on the fuel in the bowl in accordance with engine requirements. This means that for light loads a smaller quantity of fuel will be delivered to the engine.

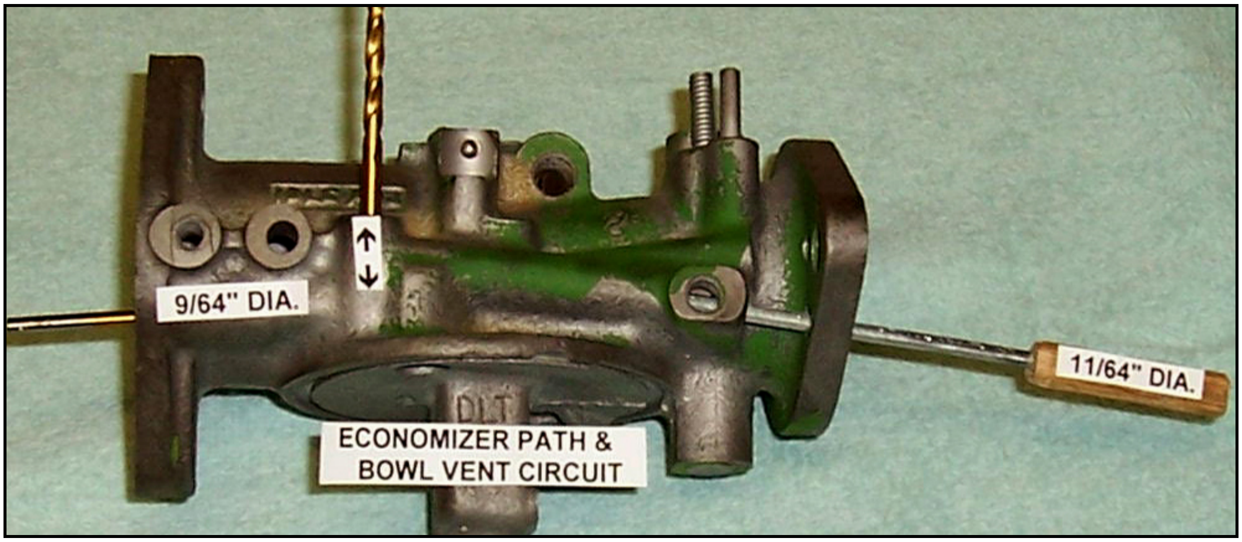

Figure 807 - Economizer Path, Air (left) to Manifold end (right)

Rough Terrain -- If you ever operated a JD-A, JD-B or JD-G tractor over rough terrain such as across corn rows while making a turn, you also probably sometimes noticed the tractor seemed to take on too much fuel, and would smoke a little and falter or miss. This is due to fuel being sloshed up into the bowl vent trap section. The fuel upset the on-going changes in air pressure on fuel contained in the bowl thus feeding excess fuel into the engine. Some would describe this as a temporarily flooding condition, and that is basically correct. In August of 1953, Deere issued instructions for modifying the bowl vent trap so as to correct this "missing of the engine" as they called it. This was pretty late in the production of these tractors, but illustrates that economizer problems were beginning to surface. See Field Service Bulletin (or FSB) No. 206, August 1953, pages 62 & 63.

Blockage, Complete or Partial -- For carburetors used on many of the A and B tractors, there exist a pair of brass baffles in the bowl vent trap to allow air to pass but block some of the fuel sloshing. As in all parts of the fuel system subject to clogging by varnish build-up, these too can become restrictive. When they do, performance of the economizer system is spoiled.

Trouble Shooting -- Several factors may affect performance of the economizer system. One is a partial or full blockage of the passageway connecting the economizer, bowl vent and bowl vent-in air opening. Accumulation of debris in the annulus can alter the metering function of the annulus and economizer plug. Finally, there is the economizer plug itself. You should see a letter stamped on the plug. Compare the letter you see with the letter listed for your carburetor to ensure you have the right economizer plug. See the **Carburetor ID Chart** (FSB 182-S, August 1951, or www.jdhpubs.com). If the letter cannot be read due to sandblasting or other abrasive processes, renewal of the plug is recommended.

5. Choke

When the engine is cold, fuel vaporizes less readily, and ignition and combustion are more difficult to sustain; thus a richer mixture (more fuel to air) is required for starting. To achieve this, a "choke" is used; this is a device that restricts the flow of air at the entrance to the carburetor. This functions similarly to the throttle being closed, except for the fact that it is closed off before both idle and load circuits. Here, the low pressure caused by the restriction sucks additional fuel through both of the fuel circuits, idle and load.

6. Float Chamber

To ensure a ready supply of fuel, the carburetor has a "float chamber (bowl)" that contains a quantity of fuel ready for use. This works similarly to a toilet tank; a float controls an inlet valve. When the float drops, the inlet is opened allowing the fuel to flow into the fuel bowl under the gravity-feed system pressure. And as fuel flow causes the float to rise, this rising action closes the inlet valve.

The level of fuel maintained in the float bowl can be adjusted by bending the small tab that makes contact with the float inlet valve. This is a fairly critical adjustment -- criteria differ, but for JD "H" carburetors, we have three indicators of a "correct" float setting. Adjust so that: (1) fuel stops flowing as the float comes to a level position, (2) there is 3/8 inch between float and body casting, and/or (3) the bowl will fill to a point 3/4-inch down from its top, and then stabilize.

These floats can spring leaks and lose their floatation. Inspect float for cracks or unsoldered joints. To test for leaks, immerse the float in hot water. Appearance of bubbles will indicate leakage. Do not attempt to repair a damaged float.

The original floats were made of natural cork and were sealed with a special varnish coating. However, the varnish would eventually deteriorate and fuel would saturate the cork, making it useless as a float. Hollow metal floats were introduced in 1946 (FSB 153-S, 6-15-46). It's highly unlikely that a cork float would have survived until today! Replace cork floats if found.

Over a long period of time, the float needle valve itself becomes worn by the fuel flow and thus fails to shut off completely. This will cause excessive fuel flow and poor engine operation. Conversely, as the fuel evaporates from the float bowl, it leaves sediment, residue, and varnishes behind, which clog the passages and can interfere with the float operations. This is particularly a problem in antique tractors operated for only a part of the year and left to stand with full float chambers for months at a time; commercial "fuel stabilizer" additives are available to reduce this problem.

Diagnosing Faulting Carburetors

Partial Quote from Robert's Carburetor Repair Webpage -- "Although many things can cause your tractor to idle incorrectly, there are three passages in the carburetor that most often will not let your tractor idle well. Three passages in the carburetor idle system are 90% of the carburetor idle problems that show up on my bench. These passages cannot be cleaned out with a wire or soaked. We are dealing with rust, not old fuel. A 6-inch long # 40 aircraft drill bit is needed to run through two of the passages. The #53 drill bit is needed for the third. These drill bits will take the passages back to their original size. You will need to remove the drill plugs to do this procedure. Remove all the drill plugs, and check all passages when overhauling your carburetor."

Expanding Robert's Data Some -- The #1 passage (IDLE AIR-FUEL MIX) is located through the front of the carburetor (manifold side) and is the top 10 x 32 drill plug (# 40 drill bit). The lower drill plug of the two is a 12 x 32. The #2 passage is located in front of, and parallel to the idle adjust screw (also IDLE FUEL-AIR MIX) (# 40 drill bit). The #3 Secret Passage is located in the bottom of the carburetor stem and across from the idle needle tip (the lower leg of the IDLE FUEL-AIR MIX) (#53 drill bit). Two other smaller, yet also important passages in the IDLE SYSTEM are the final upper legs of the IDLE path; one for the fuel-air mix (PRIMARY IDLE ORIFICE), the other for idle air (THE SECONDARY IDLE ORIFICE). These are located on the throttle valve end of the carburetor, and cleaned with a # 60 aircraft drill bit (PRIMARY) and a # 57 bit (SECONDARY) respectively. Then there is the IDLE AIR IN path, a small (#53) hole on the venturi's ridge at 3:00 o'clock as viewed from the choke end of the carburetor. For absolute definitive drilling data and bit sizes (bit # versus dia.) see CLEANING in the Overhaul section.

Protecting the carburetor -- Orifices in any carburetor are specifically designed for the functions they perform. Their primary function is to meter (to mete out) fuel in the right quantities so as to obtain desired engine performance; this being true whether starting, idling, or under a load. Drilling any of the orifices with larger bits than are called for will permanently alter metering function and may possibly render the carburetor LOST! In order to ensure that this will not occur, operate these drill bits into carburetor passageways by holding them in the hand only -- it's okay to mount a small handle on the bit. Do not chuck them up in a powered drill! It is assumed that by hand you will not be able to drill any passage way or orifice larger than it was designed to be, thus protecting the carburetor.

In fact, John Deere Service Manual SM-2024 (Carburetors) has a very blunt warning about this:
"CAUTION: Never clean holes or passageways with small drills or stiff wire, as a slight enlargement or burring of these holes will change the performance of the carburetor as well as remove rust preventive on passageways. There is no method of cleaning other than solvent."

However, if after 60-plus years rust has overwhelmed the factory-applied rust preventive, there is no choice but to use the specified drill bits. But use extreme care!

Troubleshooting -- Starting Problems are Most Common

"My tractor cannot hand start. Pull it down the street and it will start, and will run as long as the engine speed is up."

"I bought a recently-restored 1940 H and have not been able to get it started. The seller says it was running before he sold it. The carburetor was damaged in transit and replaced by a rebuilt one."
"My tractor won't start. Magneto snap is nice and crisp; it throws a blue spark across 1/4 inch gap, and it is firing at the right time for each cylinder. Compression is super -- near 80 PSI on each side, and to crank it saps my strength in no time! If I remove the plugs, squirt some gasoline into each cylinder, and reinstall the plugs, I can get both cylinders to fire, but will not start and run."

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These are typical complaints heard from "the community" of John Deere owners. There are others. Given three essential properties, a simple internal combustion engine as in two-cylinder tractors will usually start: (1) Engine compression, (2) Ignition at the correct time, and (3) Fuel in a moderately correct quantity.

Compression -- There is a direct relationship between compression and manifold vacuum. Low compression brings decreased manifold vacuum, which (in turn) decreases the draw of idle fuel-air mix during starting. Even if enough fuel is drawn with help from the choke, really low compression results in too little "kick" of a firing cylinder to start the engine. See "compression testing", Chapter 6.

In general, running a compression test is always a good practice to eliminate variables, and for the "H" tractor, an engine with compression readings of 50 PSI or more should start; even as low as 40 PSI tractors are out there being started and are working. A new engine is rated at 80 PSI. For a hand start tractor, one
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may not be able to spin the engine very fast. Thus, compression readings are likely to be lower. Perhaps equally important is that the readings be within 10% of each other.

Spark -- Verify sufficient ignition at the proper time. You should have a sharp, distinctive "snap" sound of the impulse, and a nice blue spark that will jump at least 1/4 inch! The # 1 ignition spark should occur as the flywheel L. H. IMPULSE passes its reference mark, and # 2 should occur 1/2 revolution (of the flywheel) later; as each cylinder is on its compression stroke. Make sure you have stranded metallic core wires. See **Spark testing** in Chapter 7.

Fuel -- Too little fuel makes the tractor start hard, and too much floods the engine, causing it to smoke and have very little power. Fuel tank and lines deliver fuel to the carburetor, and the carburetor is the metering device for fuel to the engine. Ensure you have fuel flow to the carburetor; then be looking for signs of either a dry, or a flooded engine.

The list here begins with debris in the fuel system causing a stoppage (Be sure to check to see that the fuel separator/fuel filter has a screen in it), a float set too low to provide fuel to the carburetor's idle needle at the point where starting fuel enters the carburetion process, and finally -- blockage of the idle pathway preventing the fuel-air mix from reaching the intake manifold.

LET'S BREAK A MYTH: Carburetor IDLE and LOAD needle settings [except for being all the way in (closed)] are not critical in engine starting. Thus, a setting of from 1-1/4 to 1-3/4 turns out for IDLE and from 3/4 to 1 turn out for LOAD needle is perfectly fine for an engine start. So, until you have your engine running, set them like this and forget about them! In fact, when your carburetor is set up correctly, a serviceable engine will start with no help from LOAD fuel at all. The LOAD needle could be completely closed!

A general pattern of troubleshooting begins to ensure we have **clean fuel**. Ensure your fuel filter has a functional screen, and if there is visible debris in the fuel sediment bowl, do a cleaning job. Place a suitable collector under the carburetor and observe fuel flow as you open the carburetor's drain cock. Let the entire bowl drain, and observe the flow rate after that point. It should continue to be a steady stream. (This is to verify open fuel lines and filters.) Sometimes a partially clogged line or filter will pass enough fuel to permit starting and idling, but will starve the engine if under a load.

Next, we want to get a feel for the **float setting**. A small device called a float level tester is helpful here; install a hose barb in place of the carburetor bowl drain cock, attach a 10 to 12 inch section of clear vinyl tube and tie (or hold) the open end up along side the carburetor. Turn on the fuel and watch the clear hose; give it time. The level of fuel showing should be approximately 3/4 inch below the top of the bowl.

Two other quick and easy checks here; (1) Back out either the Idle or Load needle and check the end for "wetting." There should be enough fuel in the bowl to wet the needle's end. This observation is more successful in the morning at highest humidity which slows evaporation of fuel from the needle taper! (2) This one, valid only for the "H" tractor, is a "volume" test. Close the drain cock and open the fuel valves to allow fuel flow into the carburetor bowl. Leave it open for a full minute. Then close the fuel valve(s), and measure the amount of fuel you can drain from the bowl. You should collect between 4 and 5 fluid ounces!

Float setting criteria -- if the carburetor's bowl were removed, this level would be achieved if the float is dead level as it closes the needle valve; a point where the float is between 3/8 and 1/2 inch below the carburetor's casting as the needle is closed. For "H" tractors, this distance is 3/8 inch.

Finally, one turns to **blockage** in the IDLE SYSTEM of the carburetor -- the source of fuel-air mix for starting. This is a very common problem with JD cast iron carburetors now some 5 of 6 decades old! See the paragraph set (below) for a short, "**no-wrench**" test you can perform to determine whether (or not) your idle and load systems are open. I might add here that cleaning the carburetor's internal passage-ways is part of an **overhaul procedure**, and if overhauling your carburetor is what you decide to do, a "must-have" is either our "H" Carburetor Overhaul Procedure (in Book or CD form). And to order, go to webpage www.jdhpubs.com, and proceed from there. This procedure has been incorporated into Chapter 8 of the 3rd Edition of the JD-H Restoration Guide. For other tractor carburetors, you are encouraged to obtain the DVD "**Carb 2**" by Robert Beaver of Robert's Carb Repair. The Green Magazine Book Store has been carrying the DVD.

Drill Bit Sets – From time to time, www.jdhpubs.com will also carry this set of four bits (for JD-H tractors). See Home page to order.

No-Wrench Testing -- LOAD and IDLE Pathways

A test is conducted to double-check your carburetor's IDLE and LOAD pathways by manipulating the IDLE and LOAD needles. Here is how it goes:

NOTE: This test involves radical adjustment of both the LOAD and IDLE needles. Before you start the engine, observe the position of each needle lever, and count the number of turns OUT that each of the two needles is at so that you can put them back where they were before this test is run.

Warning: When turning a LOAD or IDLE needle all the way in, take it gently as the needle bottoms out. Going up against the stop with too much force will damage the needle.

(1) With the tractor running at Fast Idle (full throttle – no load), turn the LOAD needle all the way in. The engine will continue to run if the IDLE SYSTEM is open, and if it stops running, the idle system IS NOT open! Assuming this test is a pass, reset the LOAD needle where is was and go on to test two below. **(Known Exception – This test may not be reliable for DLTX51 Carburetors!)**

(2) With the engine running at Fast Idle, turn the IDLE needle all the way in. The engine will continue to run provided the LOAD FUEL system is open, however, in this mode, engine operation will be a throttling pattern. As engine speed drops, the governor will open the throttle to draw LOAD FUEL because the idle path is closed. This pattern, however, indicates the LOAD FUEL channel is open and working as it should. If the engine stops running, the LOAD FUEL channel is obstructed. ++++