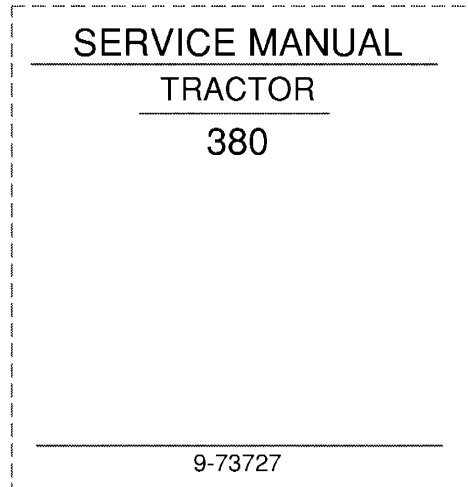


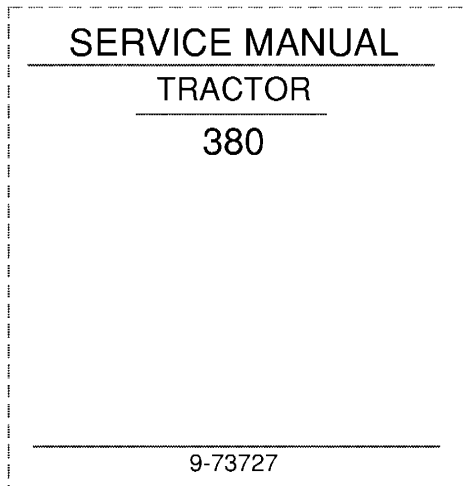
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2. Slide into pocket on Binder Spine.

TYPE 1-4



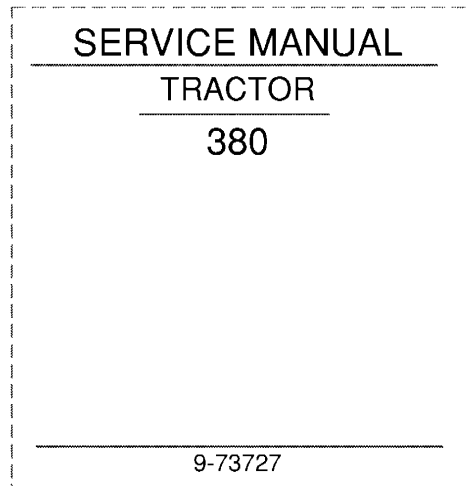
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TYPE 1-4



1. Trim along dashed line.
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TYPE 1-4



1. Trim along dashed line.
2. Slide into pocket on Binder Spine.

TYPE 1-4

380 Gen Tractor
Service Manual
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Reprinted

Section

2001

ENGINE DIAGNOSIS

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manual**

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click on it.**

**Have any questions please write to me:
admin@servicemanualperfect.com**

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GENERAL INFORMATION

Before making any repairs or adjustments on an engine, the mechanic must properly diagnose the trouble.

Locating the trouble and repairing it is only part of the job, a mechanic must find and eliminate the cause of the trouble as well. Too many repairs are made with no thought to removing the causes that made the repair necessary.

For the engine to start and perform properly, three main requirements must be present:

1. Fuel
2. Air.
3. Compression - Ignition

When any of these requirements are not present or limited for some reason, the engine will not start or will fail to operate properly throughout the power range.

Fuel

Fuel system problems can be present anywhere from the fuel tank, through the filters and injection pump as well as the injectors. Correct injection pump timing is important in the overall fuel system performance.

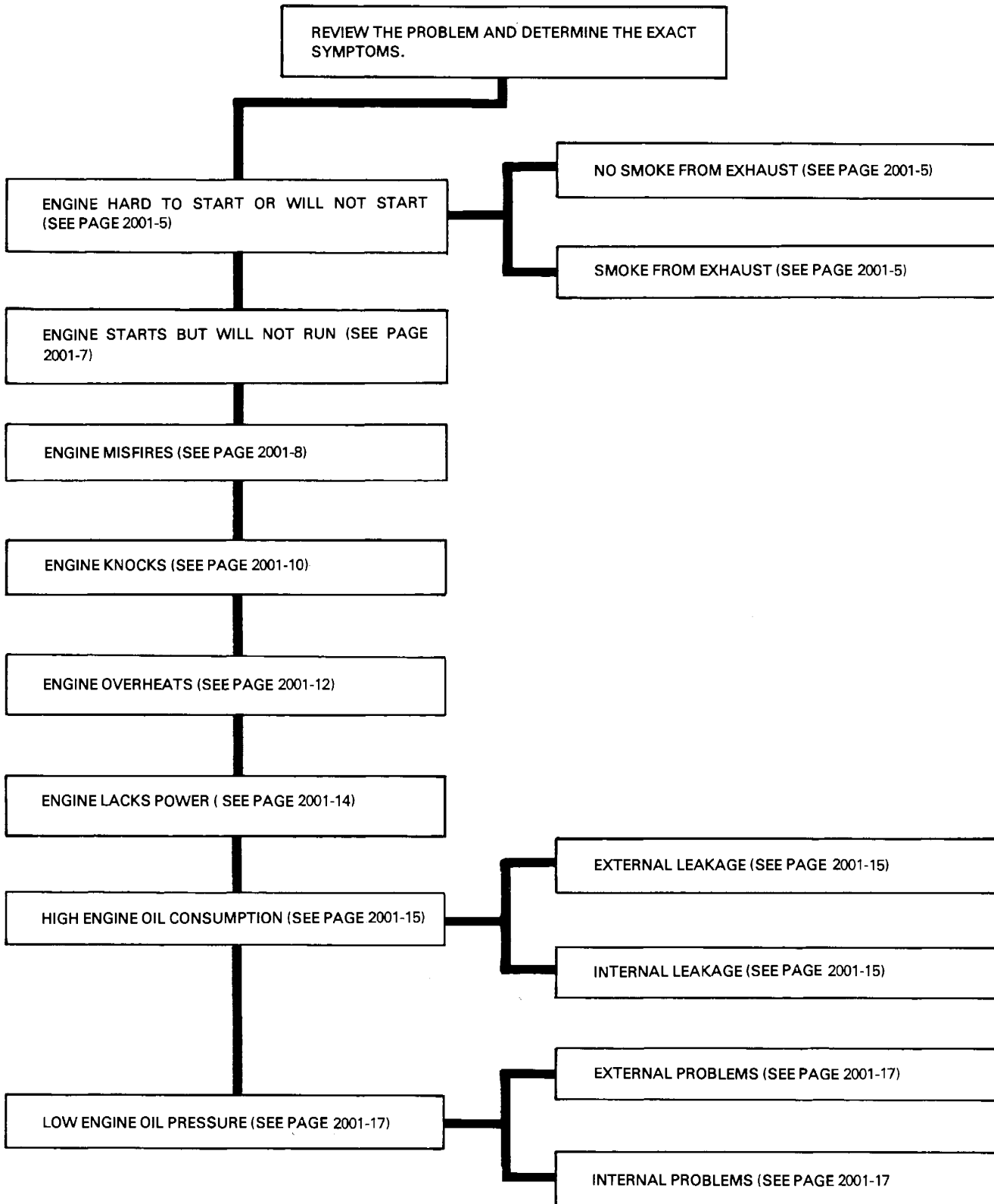
Air

Air in an engine is related to the breathing of the engine; the intake of air into the engine and the expulsion of exhaust. Proper air flow is affected by the air cleaner condition, muffler restriction, valve condition, and adjustment, cylinder head gaskets, condition of cylinder walls, rings, pistons, camshaft and crankshaft timing.

Compression - Ignition

Ignition is the result of adequate compression of the intake air in the cylinder to provide enough heat to fire the fuel being injected into the engine cylinder. Proper spray pattern and atomization of the fuel by the injector is very important. Timing the fuel injection pump to the engine is a vital requirement for proper ignition.

ENGINE DIAGNOSIS CHART



ENGINE HARD TO START OR WILL NOT START

No Smoke From Exhaust

1. **Fuel Shut-Off Not Open Completely:**
Improper cable adjustment, damaged cable, cable slipping in clamps will not allow the fuel shut-off to open completely. Check lever to be sure it is opening completely. Adjust cable.
2. **Air Filter Plugged:**
A dirty filter will cause rich fuel mixture and low engine power. Service air filter if required.
3. **Slow Cranking Speed:**
Starter must crank engine 200 to 300 rpm (r/min) in order to ignite the diesel fuel. Check engine speed while cranking. If cranking is slow, check starter amperage draw to help determine the following defective areas: batteries, cables, solenoid and starting motor.

Slow cranking speed can be caused by the following internal and external engine defects: scuffing and scoring of pistons and cylinder walls, improper crankshaft or camshaft end play, defective rod or crank bearings, oil pump, water pump and hydraulic pump.
4. **Fuel Supply Shut-Off or No Fuel:**
Check that the fuel tank to fuel pump tube is open. Check fuel supply in tank.
5. **Air In Fuel System:**
Bleed fuel system until fuel flows steadily with no bubbles. Check for air leaks at fittings between tank and fuel pump.
6. **Camshaft Damaged:**
A sheared key in the cam drive gear or a broken camshaft will throw valve and injection pump timing out of sequence affecting engine operation. Check valve timing.
7. **Fuel Injection Nozzle Not Seated In Head:**

A nozzle that is not seated in the cylinder head will leak air and not allow enough compression to fire the injected fuel. Check for damaged nozzle gasket or seals, loose nozzle, or broken stud.
8. **Fuel Line Plugged:**

A fuel line plugged with dirt will not let fuel through to the injection pump. Remove line at fuel filters and check for fuel flow through line.
9. **Clogged Fuel Filter:**

Check and service fuel filters.
10. **Wrong Fuel or Contaminated Fuel:**

Wrong fuel or contaminated fuel can cause the engine not to run or to have pre-combustion, causing serious damage to the engine. Drain fuel tank and refill with correct fuel.
11. **Piston Rings Worn:**

As piston rings become worn, they lose tension and ability to seal and wipe lubrication oil off cylinder walls. Take a compression test to determine piston ring condition. If readings are low, squirt a small amount of oil into the cylinder and retest. If compression comes up because the oil helps the rings seal, it will be necessary to install new piston rings and possibly new pistons.
12. **Injection Pump Malfunction:**

A malfunctioning injection pump will usually under-fuel the engine. Adjust or replace the injection pump.

ENGINE HARD TO START OR WILL NOT START

Smoke From Exhaust

1. **Slow Cranking Speed:**

Starter must crank engine 200 to 300 rpm (r/min) in order to ignite the diesel fuel. Check engine speed while cranking. If cranking is slow, check starter amperage draw to help determine the following problem areas: batteries, cables, solenoid, and starting motor.

Slow cranking speed can be caused by the following internal and external engine defects: scuffing and scoring of pistons and cylinder walls, improper crankshaft or camshaft end play defective rod or crank bearing, oil pump, water pump and hydraulic pump.
2. **Fuel Shut-Off Not Open Completely:**

Improper cable adjustment, damaged cable or cable slipping in clamps will not allow the fuel shut-off to open completely. Check lever to be sure it is opening completely. A partially opened lever limits the amount of fuel to the injection pump and results in low engine horsepower.
3. **Low Compression:**

Low compression on any cylinder makes the engine hard to start and rough running. Make a compression test on the engine.
4. **Air Filter Plugged:**

A dirty filter will cause rich fuel mixtures and low engine power. Service air filter if required.
5. **Fuel Injection Nozzles Malfunctioning:**

Low pressure, improper spray pattern, or plugged spray orifice will affect proper combustion in engine cylinders. Remove and test the fuel injection nozzles.
6. **Engine Timing Incorrect:**

Combustion will not occur in the cylinder at the correct moment if the engine timing is incorrect. This can cause pre-combustion and serious damage to the engine. Check for proper engine timing.
7. **Piston Rings Worn:**

As piston rings become worn, they lose tension and ability to seal and wipe lubricating oil off cylinder walls. Take a compression test to determine piston ring condition. If readings are low, squirt a small amount of oil into the cylinder and retest. If compression comes up because the oil helps the rings seal, it will be necessary to install new piston rings and possibly new pistons.
8. **Valve Push Rods Bent:**

Bent push rods will affect valve operation and not allow cylinders to get a full charge of fuel and air, or not exhaust properly. This can usually be distinguished by excessive valve tappet noise. Remove cylinder cover and check for bent push rods.
9. **Clogged Fuel Filter:**

Check and service fuel filters.
10. **Fuel Injection Nozzle Not Seated In Head:**

A nozzle that is not seated in the cylinder head will leak air and not allow enough compression to fire the injected fuel. Check for damaged nozzle gasket or seals, loose nozzle, or broken stud.
11. **Tune-up Specifications Wrong:**

Check for correct specifications when performing engine tune-up.
12. **Piston and Cylinder Walls Scuffed and Scored:**

Scuffing starts as a very small surface disturbance of torn out metal particles. This helps break down lubrication which increases heat and spreads the scuffing to adjacent areas. Scuffing and scoring are caused by malfunctioning of the lubrication system or cooling system, incorrect timing, pre-combustion, lugging or overloading, improperly fitting parts and improper break-in procedure. Remove piston assemblies and inspect.
13. **Cylinder Head Gasket Blown:**

A blown cylinder head gasket will cause one or more cylinders to lose power and cause an engine to miss. Compression leaking into the water system can also cause the cooling system pressure to rise and blow engine coolant out the radiator overflow. Take a compression test to help determine a defective head gasket, or remove radiator cap, run engine and check for gas bubbles rising in coolant at radiator opening.

14. **Piston Ring Installation Faulty or Broken Rings:**

At times, piston rings are installed wrong, upside down or wrong size. Be sure to carefully read the instructions before installing piston rings. Damaged rings can cause scoring of the cylinder walls and cause the engine to use oil.

15. **Valves Sticking:**

Sticking valves can be caused by dirty valve guides, no lubrication, rust vapors, bent valves, or carbon. A sticking valve will cause an engine miss and the valve could also hit the piston causing internal damage.

16. **Wrong Fuel or Contaminated Fuel:**

Wrong fuel or contaminated fuel can cause the

engine not to run or to have pre-combustion, causing serious damage to the engine. Drain fuel tank and refill with correct fuel.

17. **Injection Pump Malfunction:**

A malfunctioning injection pump will usually under-fuel the engine. Adjust or replace the injection pump or parts as required.

18. **Fuel Injection Line Cracked:**

A cracked or damaged fuel injector line will allow the fuel to escape externally and not inject fuel into the cylinder. This will cause an engine miss and have low horsepower. Leaking fuel from a damaged injector line can easily be seen.

ENGINE STARTS BUT WILL NOT RUN

1. **Fuel Shut-Off Not Open Completely:**

Improper cable adjustment, damaged cable and cable slipping in clamps will not allow the fuel shut-off to open completely. Check lever to be sure it is opening completely. A partially opened lever limits the amount of fuel to the injection pump and results in low engine horsepower.

2. **Air Filter Plugged:**

A dirty filter will cause rich fuel mixtures and low engine power. Service air filter if required.

3. **Air In Fuel System:**

Bleed fuel system until fuel flows steady with no air bubbles. Check for air leaks at fittings between fuel tank and injection pump.

4. **Low Fuel Supply:**

Check fuel supply in tank and refill if necessary.

5. **Low Compression:**

Low compression on any cylinder makes the engine hard to start and rough running. Make a compression test on the engine.

6. **Valve Push Rods Bent:**

Bent push rods will affect valve operation and not allow cylinders to get a full charge of fuel and air, or not exhaust properly. This can usually be distinguished by excessive valve tappet noise. Remove cylinder cover and check for bent push rods.

7. **Camshaft Damaged:**

A sheared key in the cam drive gear or a broken camshaft will throw valve timing out of sequence, affecting engine operation. Check valve timing.

8. **Wrong Fuel or Contaminated Fuel:**

Wrong fuel or contaminated fuel can cause the engine not to run or to have pre-combustion, causing serious damage to the engine. Drain fuel tank and refill with correct fuel.

9. **Clogged Fuel Filter:**

Check and service fuel filters.

10. **Fuel Injection Nozzles Malfunctioning:**

Low pressure, improper spray pattern, or plugged spray orifice will affect proper combustion in engine cylinders. Remove and test the fuel injection nozzles.

11. Cylinder Head Gasket Blown:

A blown cylinder head gasket will cause one or more cylinders to lose power and cause an engine to miss. Compression leaking into the water system can also cause the cooling system pressure to rise and blow engine coolant out the radiator overflow. Take a compression test to help determine a defective head gasket, or remove radiator cap, run engine and check for gas bubbles rising in coolant at radiator opening.

12. Piston Rings Worn:

As piston rings become worn, they lose tension and ability to seal and wipe lubricating oil off cylinder walls. Take a compression test to determine piston ring condition. If readings are low, squirt a small amount of oil into the cylinder and retest. If compression comes up because the oil helps the rings seal, it will be necessary to install new piston rings and possibly new pistons.

13. Valves Sticking:

Sticking valves can be caused by improper replacement of valve guides, no lubrication, rust vapors,

bent valves, or carbon. A sticking valve will cause an engine miss and the valve could also hit the piston causing internal damage.

14. Injection Pump Malfunction:

A malfunctioning injection pump will usually under-fuel the engine. Adjust or replace the injection pump or parts as required.

15. Fuel Injector Line Cracked:

A cracked or damaged fuel injector line will allow the fuel to escape externally and not inject fuel into the cylinder. This will cause an engine miss and low horsepower. Leaking fuel from a damaged injector line can easily be seen.

16. Injection Pump Timing Incorrect:

A fuel injection pump timed wrong will inject fuel into the cylinders at the wrong time, causing rough running, pre-combustion, low horsepower and other damage to the engine. Check for proper pump timing.

ENGINE MISFIRES

1. Wrong Fuel or Contaminated Fuel:

Wrong fuel or contaminated fuel can cause the engine not to run or to have pre-combustion, causing serious damage to the engine. Drain fuel tank and refill with correct fuel.

2. Valve Push Rods Bent:

Bent push rods will affect valve operation and not allow cylinders to get a full charge of fuel and air, or not exhaust properly. This can usually be distinguished by excessive valve tappet noise. Remove cylinder cover and check for bent push rods.

3. Fuel Injection Nozzles Malfunctioning:

Low pressure, improper spray pattern or plugged orifice will affect proper combustion in engine cylinders. Isolate faulty injector nozzle and remove.

4. Fuel Injection Nozzle Not Seated In Head:

A fuel injection nozzle that is not seated in the cylinder head will leak air and not allow enough compression to fire the injected diesel fuel. A

damaged nozzle gasket or seals, loose nozzle, or broken stud can cause the nozzle not to be seated correctly.

5. Cylinder Head Gasket Blown:

A blown cylinder head gasket will cause one or more cylinders to lose power and cause an engine to miss. Compression leaking into the water system can also cause the cooling system pressure to rise and blow engine coolant out the radiator overflow. Take a compression test to help determine a defective head gasket, or remove radiator cap, run engine and check for gas bubbles rising in coolant at radiator opening.

6. Low Compression:

Low compression on several cylinders, makes the engine hard to start and rough running. Make a compression test on the engine.

7. Fuel Injection Line Cracked:

A cracked or damaged fuel injector line will allow fuel to escape externally and inject fuel into the

cylinder. This will cause an engine miss and low horsepower. Leaking fuel from a damaged injector line can easily be seen.

8. Injection Pump Malfunction:

A malfunctioning injection pump will usually under-fuel the engine. Adjust or replace the injection pump or parts as required.

9. Injection Pump Timing Incorrect:

A fuel injection pump timed wrong will inject fuel into the cylinders at the wrong time, causing rough running, pre-combustion, low horsepower and other damage to the engine. Check for proper pump timing.

10. Intake Manifold Gasket Damaged:

A damaged intake manifold gasket can reduce the manifold pressure and cause an insufficient air-fuel mixture in the cylinders and result in low power.

11. Cylinder Head or Block Cracked:

A cracked head or block will usually allow engine coolant to enter the engine. This will cause an engine miss or pressure rise in the cooling system depending on how bad the leak is. Low coolant level, high oil level, engine missing, and blowing water out the exhaust are evidence that coolant is getting into the engine combustion chambers.

12. Valves Damaged:

Damaged valves are caused by wear, improper grinding, improper timing, wrong adjustment, loose seat, or broken valve spring. Defective valves can usually be heard through the intake or exhaust manifold. A low reading compression test usually indicates defective valves.

13. Valve Spring Worn:

Weak valve springs will allow the valves to float at high speed. Broken valve springs will not close valve completely and allows the valve to hit the piston doing internal engine damage. Always check and test valve springs when doing a valve job.

14. Operating Temperature Low:

The engine was designed for and will only develop full horsepower within its correct operating temperature range. Low operating temperature can result from a malfunctioning thermostat. Do not remove thermostat during the summer. Maintain 50% of permanent anti-freeze all year for more efficient operation.

15. Engine Pre-combustion:

Pre-combustion is the igniting of the fuel before the normal compression point occurs. This can cause severe knocking and engine power loss. High temperature and pressure from pre-combustion will cause other serious internal damage to the engine. The following are causes of pre-combustion:

- A. Valves operating at higher than normal temperature because of excessive guide clearance or improper seal with valve seats.
- B. Hot spots caused by an inefficient or damaged cooling system.
- C. Injection nozzles set at incorrect pressure.
- D. Sharp edges in combustion chamber.
- E. Timing incorrect.
- F. Excessive lugging of engine.
- G. Defective injection pump.
- H. Wrong or contaminated fuel.

16. Valves Sticking

Sticking valves can be caused by dirty valve guides, no lubrication, rust vapors, bent valves or carbon. A sticking valve will cause an engine miss and allows the valve to also hit the piston causing internal damage.

17. Bent Connecting Rod:

A bent connecting rod will cause piston slap from scoring due to misalignment. The engine will run rough because of incomplete combustion and emit white exhaust smoke from the bad cylinder. Remove engine oil pan and inspect connecting rods

for alignment. A comparison of piston heights at Top Dead Center with cylinder head removed can quickly indicate a bent rod condition. A difference of .020 inch (0.51 mm) in connecting rod can cause a noticeable miss at low RPM and cold engine conditions.

18. Tune-up Specifications Incorrect:

Check for correct specifications when performing engine tune-up.

ENGINE KNOCKS

1. Engine Timing Incorrect:

Combustion will not occur in the cylinder at the correct moment if the engine timing is incorrect. This can cause pre-combustion and serious damage to the engine. Check for proper engine timing.

2. Flywheel Loose:

A loose flywheel will chuck or pound at low speed making the engine sound like it has a loose connecting rod. As speed increases, the knock will go away. Replace flywheel if badly worn.

3. Engine Pre-combustion:

Pre-combustion is the igniting of the fuel before the normal compression point occurs. This can cause severe knocking and engine power loss. High temperature and pressure from pre-combustion will cause other serious internal damage to the engine. The following are causes of pre-combustion:

- A. Valves operating at higher than normal temperature because of excessive guide clearance or improper seal with valve seats.
- B. Hot spots caused by an inefficient or damaged cooling system.
- C. Injection nozzles set at incorrect pressure.
- D. Sharp edges in combustion chamber.
- E. Timing incorrect.
- F. Excessive lugging of engine.
- G. Defective injection pump.
- H. Wrong or contaminated fuel.

4. Rod Bearing Worn:

A rod bearing going bad will have a sharp metallic sound which will increase as engine speed in-

creases. When the cylinder with the bad knock is grounded by cracking the injector line, the knock will stop or decrease considerably. Remove the engine oil pan and check rods with plasti-gauge.

5. Main Bearing Worn:

A worn main bearing will have a thudding sound and increased engine vibration. Both symptoms will increase as engine speed increases. By grounding out (cracking injector line) the problem cylinder, the thudding sound will stop or decrease but the vibration will remain. Remove engine oil pan and check main bearing clearance with plasti-gauge. Also, low oil pressure can be the result of worn main bearings and excessive oil clearance.

6. Piston and Cylinder Walls Scuffed and Scored:

Scuffing starts as a very small surface disturbance of torn out metal particles. This helps break down lubrication which increases heat and spreads the scuffing to adjacent areas. Scuffing and scoring are caused by malfunctioning of the lubrication system or cooling system, incorrect timing, pre-combustion, lugging or over-loading, improperly fitting parts and improper break-in procedure. Remove piston assemblies and inspect.

7. Piston Ring Installation Faulty or Broken Rings:

At times piston rings are installed wrong, upside down or the wrong size. Be sure to carefully read the instructions before installing piston rings. Damaged rings can cause scoring of the cylinder walls and cause the engine to use oil.

8. Bent Connecting Rod:

A bent connecting rod will cause piston slap from scoring due to misalignment. The engine will run rough because of incomplete combustion and emit white exhaust smoke from the bad cylinder. Remove engine oil pan and inspect connecting rods for alignment. A comparison of piston heights at Top Dead Center with cylinder heads removed

can quickly indicate a bent rod condition. A difference of .020 inch (0.51 mm) in connecting rod can cause a noticeable miss at low rpm (r/min) and cold engine conditions.

9. Valve Spring Weak:

Weak valve springs will allow the valves to float at high speed. Broken valve springs will not close valve completely and allow the valve to hit the piston doing internal engine damage. Always check and test valve springs when doing a valve job.

10. Piston Pin or Bushing Worn:

Piston pin or bushing knock will increase with speed. When grounding out the cylinder (cracking injector line) the knock will be twice as bad. Due to combustion, every other revolution will keep the piston pin and bushing tight giving no knock. Remove and inspect piston assembly producing the knock.

11. Foreign Material In Cylinders:

Foreign material such as pieces of broken valve, bolts, nuts, washers, or pieces of castings, in the cylinder will cause a noise everytime the piston

comes to Top Dead Center. The noise will not change by shorting out the cylinder. Due to the metal-to-metal contact, the vibration can be felt on the side of the engine. Remove cylinder heads and inspect.

12. Cylinder Ridge (Ring Groove) Not Removed:

When performing an engine overhaul and installing new rings, the cylinder ridge (ring groove) must be removed. If the ridge is not removed, it will cause the engine to knock on all cylinders as the top piston ring hits the ridge on every stroke. If the top ring continues to hit the ridge, it will cause ring land breakage between top and second ring, causing piston and cylinder wall scuffing and scoring. Remove heads and check for cylinder ridge.

13. Improper Use of Starting Fluid:

Spraying ether into the engine air intake without cranking the engine, will cause one or more cylinders to receive a large amount of ether due to open valves. Then, when the engine is cranked, volatile, uncontrolled explosions will occur in these cylinders breaking ring lands and damaging the piston. Be sure engine is cranking before using ether. Remove cylinder heads and inspect pistons for damage.

ENGINE OVERHEATS

1. **Fan Belt Loose:**

Check fan belt for proper tension. Check that the belt is not covered with oil or worn badly and riding very deep in pulley groove. Check for pulley groove wear.
2. **Low Coolant Level:**

Check coolant level in radiator and refill if necessary.
3. **Water Pump Malfunction:**

Remove the radiator cap and observe the coolant to see if there is movement which indicates the water pump is pumping. Move the fan back and forth to check for any defective bearings. Check around the water pump for any signs of coolant leakage indicating a bad water pump seal. Remove water pump and rebuild or replace.
4. **Thermostat Inoperative:**

If there is high coolant temperature and boiling coolant, replace thermostat.
5. **Engine Timing Incorrect:**

Combustion will not occur in the cylinder at the correct moment if the engine timing is incorrect. This can cause pre-combustion and serious damage to the engine. Check for proper engine timing.
6. **Tractor Mechanical Drag:**

A mechanical drag on a unit can cause low horsepower and engine overheating. Causes of some mechanical drags are defective brakes, bad bearings or gears in transmission.
7. **Radiator Cap Inoperative:**

Test radiator cap to see that it relieves at the correct pressure. Inspect cap gasket for proper sealing. An inoperative cap can cause water pump cavitation and lower coolant boiling points.
8. **Radiator Fins Bent:**

Bent or damaged fins can cause a cooling system to overheat because of restricted air flow through the radiator core. All of the fin area is needed to dissipate the engine heat from the radiator.
9. **Radiator Fins Plugged With Dirt:**

Radiator fins must be clean so air can flow through the radiator fins and help dissipate the heat of the coolant. Items that affect radiator cooling are: oil and grease on fins, leaves, and attachments covering radiator air inlet.
10. **Cylinder Head Gasket Blown:**

A blown cylinder head gasket will cause one or more cylinders to lose power and cause an engine to miss. Compression leaking into the water system can also cause the cooling system pressure to rise and blow engine coolant out the radiator overflow. Take a compression test to help determine a defective head gasket, or remove radiator cap, run engine and check for gas bubbles rising in coolant at radiator opening.
11. **Injection Pump Malfunction:**

A malfunctioning injection pump will usually under-fuel the engine. Adjust or replace the injection pump or parts as required.
12. **Radiator Baffling Missing:**

The removal of radiator shrouding will cause cooling air flow to escape around the radiator instead of drawing in cool external air through the radiator.
13. **Engine Low On Oil:**

An engine low on oil can lose lubrication to internal parts and start scoring pistons, cylinder walls and damage engine bearings. Proper oil level is required to help dissipate some of the engine heat. Check engine oil level every eight hours of operation. Low engine oil can also give low oil pressure readings.
14. **Wrong Fuel or Contaminated Fuel:**

Wrong fuel or contaminated fuel can cause the engine not to run or to have pre-combustion, causing serious damage to the engine. Drain fuel tank and refill with correct fuel.

15. Piston and Cylinder Walls Scuffed and Scored:

Scuffing starts as a very small surface disturbance of torn out metal particles. This helps break down lubrication which increases heat and spreads the scuffing to adjacent areas. Scuffing and scoring are caused by malfunctioning of the lubrication system or cooling system, incorrect timing, pre-combustion, lugging or overloading, improperly fitted parts and improper break-in procedure. Remove piston assemblies and inspect.

16. Water Pump Hose Worn:

Water pump hoses can become worn from age and collapsing, cracking, chaffing against something or fan belts cutting through them. Inspect hoses for coolant leaks.

17. Gauge or Sending Unit Malfunction:

A bad ground on gauges or sending units can many times be the only problem with a defective gauge. Take a jump wire and ground gauge or sending unit to machine, then recheck gauge. Pipe tape is often used to seal threads on oil sending units which destroys the biggest share of its' grounding ability.

18. Cylinder Head or Block Cracked:

A cracked cylinder head or block will usually allow engine coolant to enter the engine, causing engine miss or pressure rise in the cooling system depending upon how bad the leak is. Low coolant level, high oil level, engine missing when first started, and water blowing out the exhaust are indications that coolant is getting into the engine combustion chambers.

19. Lack of Anti-Freeze:

To illustrate the importance of having anti-freeze in the cooling system year around, consider the following. Any ethylene glycol anti-freeze with a 50% mixture and a 7 PSI (48 kPa) cap will raise the coolant boiling point to 242° F. (117° C.). A 70% mixture will raise the boiling point to 253° F. (122° C.). With just water in the above cooling system, it would boil at 233° F. (111° C.)

20. Radiator Leaking Externally:

Inspect and repair or replace leaking radiator.

21. Tune-up Specifications Wrong:

Check for correct specifications when performing engine tune-up.

22. Engine Pre-combustion:

Pre-combustion is the igniting of the fuel before the normal compression point occurs. This can cause severe knocking and engine power loss. High temperature and pressure from pre-combustion will cause other serious internal damage to the engine. The following are causes of pre-combustion:

- A. Valves operating at higher than normal temperature because of excessive guide clearance or improper seal with valve seats.
- B. Hot spots caused by an inefficient or damaged cooling system.
- C. Injection nozzles set at incorrect pressure.
- D. Sharp edges in combustion chamber.
- E. Timing incorrect.
- F. Excessive lugging of engine.
- G. Defective injection pump.
- H. Wrong or contaminated fuel.

23. Water Temperature Gauge Malfunction:

The water temperature gauge, wiring, resistor or sending unit can give false or no temperature readings. To diagnose, remove wire at sending unit and ground to tractor. Turn key switch on, if gauge comes up, sending unit is functioning. If gauge does not come, use voltmeter and ohmmeter to check wiring circuit.

ENGINE LACKS POWER

1. **Fuel Shut-Off Not Open Completely:**
Improper cable adjustment, damaged cable, or cable slipping in clamps will not allow the fuel shut-off to open completely. Check lever to be sure it is opening completely. A partially opened lever limits the amount of fuel to the injection pump and results in low engine horsepower.
2. **Low Engine Speed:**
Check engine for correct rpm (r/min).
3. **Tractor Mechanical Drag:**
A mechanical drag on a unit can cause low horsepower and engine overheating. Causes of some mechanical drags are damaged brakes, bad bearings or gears in transmission.
4. **Air Filter Plugged:**
A dirty filter will cause rich fuel mixtures and low engine power. Service air filter if required.
5. **Wrong Fuel or Contaminated Fuel:**
Wrong fuel or contaminated fuel can cause the engine not to run or to have pre-combustion, causing serious damage to the engine. Drain fuel tank and refill with correct fuel.
6. **Operating Temperature Low:**
The engine was designed for and will only develop full horsepower within a specific temperature range. Low temperature can result from defective thermostat. Do not remove thermostat during summer. Maintain 50% of permanent anti-freeze all year for more efficient operation.
7. **Engine Timing Incorrect:**
Combustion will not occur in the cylinder at the correct moment if the engine timing is incorrect. This can cause pre-combustion and serious damage to the engine. Check for proper engine timing.
8. **Low Compression:**
Low compression on several cylinders makes the engine hard to start and also does not generate enough heat to properly fire on all cylinders and continue running. Make a compression check on the engine.
9. **Fuel Injection Nozzles Malfunctioning:**
Low pressure, improper spray pattern, or plugged spray orifice will affect proper combustion in engine cylinders. Remove and test the fuel injection nozzles.
10. **Clogged Fuel Filter:**
Check and service fuel filters.
11. **Air In Fuel System:**
Bleed fuel system until fuel flows steady with no air bubbles. Check for air leaks at fittings between fuel tank and injection pump.
12. **Camshaft Timing Wrong:**
A camshaft can be installed one tooth out of time making all valves operate out of normal timing sequence in relation to the crankshaft. This would not allow the engine to develop full power or run smoothly. Valves can hit the pistons causing internal damage.
13. **Crankcase Too Full of Oil:**
An over-full or completely full crankcase can cause a loss of power because the crankshaft is trying to turn in the extra high oil level. High oil level can be caused by coolant or fuel leakage into the crankcase or extra engine oil.
14. **Valves Damaged:**
Damaged valves are caused by wear, improper grinding, hitting the pistons, wrong adjustment, loose seat, or broken valve spring. Defective valves can usually be heard through the intake or exhaust manifold. A low compression test reading usually indicates defective valves.
15. **Valves Out of Adjustment:**
Careful valve adjustment is important to obtain a complete supply of fuel and air and to completely exhaust burned gases. Valves out of adjustment can cause damaged valves, valve seat wear, bent push rods, damaged pistons, rocker arm wear and camshaft wear.

16. Injection Pump Malfunction:

A malfunctioning injection pump will usually under-fuel the engine. Adjust or replace the injection pump or parts as required.

17. Fuel Line Plugged:

A fuel line plugged with rust or dirt will not allow fuel through to the fuel injection pump. Remove

line at injection pump and check fuel flow.

18. Engine Drag:

Lack of power can be caused by the following internal and external engine defects: scuffing and scoring of pistons and cylinder walls, improper crankshaft or camshaft end play, worn rod or crank bearings, oil pump, water pump, or hydraulic pump.

HIGH ENGINE OIL COMSUMPTION

External Leakage

1. Engine External Oil Leakage:

Check for engine external oil leaks at the following locations:

- | | |
|--|---|
| <ul style="list-style-type: none"> a. Covers b. Accessories c. Valve cover gasket d. Oil pan gasket e. Timing gear cover gasket | <ul style="list-style-type: none"> f. External oil lines g. Camshaft welch plug h. Engine oil filter i. Oil drain plug gasket j. Front and rear crankshaft seal k. Crankcase breather l. Injection pump mounting gasket. |
|--|---|

Internal Leakage

1. Engine Internal Oil Leakage:

Check for engine internal oil leaks in the cylinder head assembly and engine block assembly.

2. Valve Guides Worn:

Excessively worn valve guides can account for high oil consumption. Gravity, inertia and air pressure differences act to force oil through the intake and exhaust valve guides. To checkout valve guides, restrict lubricating oil flow to the rocker assemblies for a short time. Run engine at idle and then accelerate quickly. If dark blue exhaust clears up, the valve guides are worn and defective.

3. Rocker Arm Assembly Worn:

Worn rocker arm assemblies allow larger than normal amounts of lubricating oil into the valve compartment. The extra quantity of oil increases oil consumption past the valve guides. Run the engine with valve cover removed and check for excessive oil or oil flow from the rocker arms.

4. Piston and Cylinder Walls Scuffed and Scored:

Scuffing starts as a very small surface disturbance of torn out metal particles. This helps breakdown lubrication which increases heat and spreads the scuffing to adjacent areas. Scuffing and scoring are caused by malfunctioning of the lubricating system, or cooling system, incorrect timing, pre-combustion, lugging or overloading, improperly fitted parts and improper break-in procedure. Remove the piston assemblies and inspect.

5. Piston Rings Worn:

As piston rings become worn, they lose tension and ability to seal and wipe lubricating oil off cylinder walls. Take a compression test to determine piston ring condition. If readings are low, squirt a small amount of oil into the cylinder and retest. If compression comes up because the oil helps the rings seal, it will be necessary to install new piston rings and possibly new pistons.

6. **Excessive Oil In Rocker Arm Compartment:**

Excessive oil in rocker arm compartments can be caused by wrong rocker arms, rocker arm shafts indexed wrong, worn rocker arm busings, high oil pressure and poor oil drainage back to crankcase. Remove cylinder cover and check for above problems.

7. **Engine Speed Too High:**

Running at speeds higher than the engine is designed for will aggravate all oil consumption areas such as oil pressure, oil flow, throwoff onto cylinder walls and oil in rocker arm compartments. Check engine speeds and set according to specifications.

8. **Connecting Rod Bearings Worn:**

Worn rod bearings cause more than normal throw-off of lubricating oil to cylinder pistons and liners. This excess oil is sometimes more than worn piston oil rings can control. The oil then passes the rings and on into the combustion chamber. Remove the engine oil pan and check rod bearings for wear using plasti-gauge. A worn rod bearing can cause the engine to knock and have low oil pressure.

9. **Engine Oil Too Light:**

Using engine oil that is too light will aggravate all oil consumption areas because of additional oil flow and leakage of the lighter oil. Light engine oil will give lower than normal oil pressure readings. Check for proper weight oil and change oil if required.

10. **Piston Rings Not Seated:**

Most piston rings will seat in the first few hours of operation. If engine continues to use oil, it is usually a problem other than piston rings. Items that can cause rings not to seat are: out-of-round cylinder,

improper deglazing of cylinders, rings installed wrong or improper break-in procedure. Do not add abrasives to intake system to seat rings. If it is suspected that rings are not seated, tear down engine and inspect.

11. **Engine Oil Pressure Too High:**

High oil pressure will cause additional oil throw-off from connecting rod bearings for lubrication of cylinder walls. This additional oil can be more oil than worn piston rings can control. High oil pressure will cause excessive oil in all areas and can cause oil consumption. Remove engine oil pan and adjust oil pump relief valve.

12. **Piston Ring Installation Faulty or Broken Rings:**

At times, piston rings are installed wrong, upside down or wrong size. Be sure to carefully read instructions before installing piston rings. Damaged rings can cause scoring of the cylinder walls and cause the engine to use oil.

13. **Cylinder Head Gasket Damaged:**

A cylinder head gasket can be damaged or installed wrong allowing lubricating oil to enter the combustion chamber and to be burned in the engine. Remove cylinder head and check gasket if all other tests check out all right.

14. **Oil Leakage Past Valve Guides and Valve:**

Excessive valve stem-to-guide clearance can cause high oil consumption. A heavy carbon build-up on valve stems and face is the result of excessive oil leakage past valve guides, also a noticeable loss of engine power can result.

LOW ENGINE OIL PRESSURE

External Problems

1. **External Oil Leakage:**
Check for oil leakage at the oil filter, external oil lines.
2. **Oil Pressure Light Malfunction:**
Replace bulb and check wiring.
3. **Oil Pressure Sending Unit Malfunction:**
Disconnect wire from sending unit to dash light Ground this wire and turn on key switch. If light comes on, problem is in the sending unit.
4. **Oil Pressure Warning Light Wiring Damaged:**
5. **Bad Ground On Light or Sending Unit:**
If the wiring is grounded at the sending unit with the key on and the light does not light, problem lies in the light or wiring. Hook a jumper wire from light terminal to ground and turn on the key. If light comes on, the problem is in the wiring. Replace the wiring harness or run a separate wire for oil pressure warning light.
A bad ground on lights or sending units can many times be the only problem with a malfunctioning gauge. Take a jump wire and ground gauge or sending unit to machine, then recheck gauge. Pipe tape is often used to seal threads on oil sending units which destroys the biggest share of its' grounding ability.

Internal Problems

1. **Engine Low On Oil:**
An engine low on oil can lose lubrication to internal parts and start scoring pistons, cylinder walls and damage engine bearings. Proper oil level is required to help dissipate some of the engine heat. Check engine oil level every eight hours of operation. Low engine oil can also give low oil pressure readings.
come off the engine oil pump from improper installation. With the pick up screen off, the pump will have little or no oil pressure. Remove oil pan and inspect oil pump suction assembly.
2. **Oil Pump Relief Malfunction:**
Low engine oil pressure readings can be caused by a malfunctioning oil pump relief valve. A broken spring, a piece of metal under valve seat or abrasives can cause relief valve to score and hang up. Remove engine oil pan and oil pump assembly. Inspect pump relief valve and repair as necessary.
3. **Engine Oil Too Light:**
Using engine oil that is too light will aggravate all oil consumption areas because of additional oil flow and leakage of the lighter oil. Light engine oil will give lower than normal oil pressure readings. Check for proper weight oil and change oil if required.
4. **Oil Pump Suction Assembly Off Pump:**
It is possible for the oil pump suction assembly to
5. **Engine Oil Pump Worn:**
The engine oil pump can be worn from long service and contaminates in the oil. Remove engine oil pan and inspect oil pump.
6. **Engine Main Bearings Worn:**
A worn main bearing will have a thudding sound and increased engine vibration. Both symptoms will increase as engine speed increases. By grounding out (cracking injector line) of the problem cylinder, the thudding sound will stop or decrease but the vibration will remain. Remove engine oil pan and check main bearing clearance with plastigauge. Also, low oil pressure can be the result of worn main bearings and excessive oil clearance.
7. **Connecting Rod Bearings Worn:**
Worn rod bearings cause more than normal throw off of lubricating oil to cylinder pistons and liners. This excess oil is sometimes more than worn piston

oil rings can control. The oil then passes the rings and on into the combustion chamber. Remove the engine oil pan and check rod bearings for wear using plasti-gauge. A worn rod bearing can cause the engine to knock and low oil pressure.

8. Rocker Arm Assembly Worn:

Worn rocker arm assemblies allow larger than normal amounts of lubricating oil into the valve compartment. The extra quantity of oil increases oil consumption past the valve guides. Run the engine with valve cover removed and check for excessive oil or oil flow from the rocker arms.

9. Oil Pump Suction Screen Plugged:

The oil pump suction screen can become plugged with sludge, metal filings and other contaminants in the oil. Many times the oil pressure will be normal when engine is first started. The longer the

unit runs, the more contaminants are collected on the pick-up screen shutting off the supply of suction oil. Remove engine oil pan and inspect oil pump screen.

10. Internal Oil Passage Leak:

A crack, missing plug, or bad O-ring can cause an internal oil passage leak resulting in low oil pressure readings. If such leakage is suspected, attach air pressure to the oil passage and watch for leaks with oil pan removed.

11. Key In Oil Pump Gear Worn:

The key in the oil pump drive gear can become worn and shear. Remove oil pan and oil pump, disassemble oil pump and inspect.