



California Vocational Agriculture Curriculum Guidelines Instructional Unit

ENGINE TUNE UP

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Teaching Outline

I. Engine Tune Up

Engine tune up is probably the most important preventive maintenance that can be performed on a machine. However, most operators make the mistake of performing tune up only when the engine is not running satisfactorily. This is often a costly error because at this point the engine may be worn or damaged until it requires major repair or overhaul. Not only could these costly repairs be avoided by good maintenance, but operating costs could also be saved.

A. What is a Tune Up?

Tune up is the process of making checks and minor adjustments to improve the operation of the engine. Tune up is also preventative maintenance. Troubles can be caught early and prevented by checking out the engine before it actually fails.

B. When Should an Engine be Tuned?

Regularly. The intervals for tune up may vary from 500 to 1,000 hours or each spring and fall, depending upon the operating conditions. But regularity is the key to tuning the engine so that major problems are prevented. A badly worn engine cannot be tuned up. This is why the engine should first be checked to see if:

1. A tune up will restore it, or
2. Major overhaul is needed.

II. Visual Inspection, TM 1

By inspecting the engine before tuning it, you can learn a lot about its general condition.

A. Oil and Water Leakage:

Inspect the engine for any oil or water leaks. If the engine has been using too much oil, this often means an external oil leak. If the engine overheats, look for leaks in the cooling system.

B. Electrical System:

1. Inspect the battery for corrosion, cracked, case, or leaks at the cell covers. Remove the cell caps and examine the tops of the battery plates.

ENGINE TUNE UP

Unit Goal

The goal of this unit is to aid the students' development of knowledge and skills related to engine tune up.

Unit Objectives

Upon completion of this unit the student will be able to:

1. Identify conditions that could lead to engine failure.
2. Perform the tune up procedures listed on the tune up chart in this unit.

SUGGESTED LEARNING ACTIVITIES

- II. 1. Have students perform visual inspection of one or more tractors and record deficiencies.
2. Have students participate in farm power contest at Field Day.

SUGGESTED RESOURCE MATERIALS

1. Local dealer, John Deere FMO, Tractors and Preventive Maintenance.
2. CATA Curricular Code.

- II. B. 2. If they are covered with a chalky deposit, this means one of three things:
 - a. Electrolyte level has been too low.
 - b. Battery charge has been too low, causing sulfation.
 - c. Battery was charged at too high a rate, boiling out water.
3. Any of these conditions can reduce the life of the battery. If they have gone too far, the battery must be replaced.
4. Check the battery cables and connections for damage and looseness.
5. Be sure the cables are the right size. Many complaints of poor starting can be traced to battery cables that are too small.
6. To check for this, operate the starter with the engine cold. If the battery cable gets hot, the cable is probably too small.
7. Inspect the wiring harnesses. If they are too oil-soaked, frayed, or corroded, replace them.
8. On spark-ignition engines, check the distributor for a cracked cap, excessive grease, or other damage.
9. Check the operation of the alternator or generator gauge or voltmeter. It should light or register when the starter switch is turned on.
10. Failure can be due to a burned-out bulb, an incomplete circuit, or the alternator or generator is not producing current. (Lack of current to the battery will show up a discharged battery).
11. If the oil pressure indicator light does not go out or register normal when the engine is running check for low or no oil pressure, or a short circuit.
12. Stop the engine at once and find the cause.
13. Lack of engine oil pressure can result in failure of expensive parts inside the engine due to lack of lubrication.

C. Cooling System

1. Wait until the engine has been idle for several hours and the crankcase oil is cold; then loosen the crankcase drain plug and carefully turn it out to see if any water seeps out. If water is present, locate the cause of the cooling system leak.
2. Inspect the cooling system for leaks, deteriorated hoses, bent or clogged radiator fins, slipping fan belt, or any other condition which could result

SUGGESTED LEARNING ACTIVITIES

SUGGESTED RESOURCE MATERIALS

II. C. in improper cooling.

D. Air Intake System

Inspect the air intake system for possible leaks or restrictions. If the proper amount of clean air does not reach the engine, performance and durability will be affected.

E. Fuel System

1. Check the fuel system for leaks and for bent or dented lines, which might cause a restriction.
2. Check the fuel transfer pump sediment bowl. On diesel engines, inspect the fuel filters for dirt, water, or other foreign matter.

F. Steam Cleaning

After checking for leaks, steam clean the engine. This cleans the engine, makes tune up easier and troubles easier to spot.

G. Dynamometer Tests

1. If possible, test the engine on a dynamometer both before and after it is tuned. Before tune up, this test gives you the horsepower output and fuel consumption of the engine as it is. Consider both hours of operation and the conditions under which the engine has been operated. It is far more economical in the long run to tune the engine before a lack of performance makes it mandatory.
2. Remember: Most manufacturers suggest a regular period of operation between tune ups, such as spring and fall, or every 500 or 1,000 hours of operation.

III. Engine Tune Up Chart -- TM 2

- A. The chart gives a capsule of the steps necessary to tune your engine at the recommended intervals.
- B. If, after performing these tune up steps, the engine fails to respond properly, have a service shop make further tests. The engine may require adjustments or repairs that you are not able to perform because of the special tools and knowledge required.

IV. Dynamometer Tests After Tune Up

The dynamometer test is the final check of overall engine performance after tune up.

SUGGESTED LEARNING ACTIVITIES

- III. 1. Have students perform tune up steps.

SUGGESTED RESOURCE MATERIALS

1. School equipment or local farmer.

- IV. It will tell you whether the tune up has been adequate. Compare it with the dynamometer test made before tune up.
- A. Test for the following things:
 - 1. Engine horsepower
 - 2. Exhaust analysis, smoke analysis (diesel), and carburetor adjustment (spark ignition).
 - 3. Fuel consumption
 - 4. Crankcase Blow-by
 - B. Most dynamometer manufacturers have instruments to be used with the dynamometer for checking the above items.
 - C. Use the engine Technical Manual for procedures and specifications.
 - D. Note: If the engine fails to produce the desired horsepower, and an air cleaner restriction test was not made at the beginning, make one now. It is possible that an air restriction is causing the loss of horsepower.
 - E. A completely tuned engine should pass the dynamometer test with no problems.
 - F. However, the engine should not put out more horsepower than it was designed for. Tampering with the engine to get extra horsepower will shorten engine life and raise operating costs. It may also void the engine warranty.

V. Summary: Engine Tune Up

Tune up of an engine may seem like a long ordeal. Actually, most of the items can be checked in a minute or two. But why check out so many items if the engine has not actually failed? The answer is that tune up is preventive maintenance. Before the engine fails, we keep it tuned up so that causes are corrected early, and possible causes are prevented. Tune up catches the problems early -- in the farm shop, not in the field.

Shop costs are much cheaper than field costs, and by scheduling the tune up during a lull in operation, costly downtime at peak periods can be prevented. Tune up means that the engine is ready to go and the operator can depend on it for some long and productive hours on the job.

SUGGESTED LEARNING ACTIVITIES

- IV. 1. Field trip to local dealer
to observe dynamometer tests.

SUGGESTED RESOURCE MATERIALS

1. Local dealer.

Student Evaluation

True-False:

_____ 1. A badly worn engine can be restored by a complete tune up.

Written:

2. Before tuning up an engine, what should be done?

3. When should dynamometer tests be made?

Practical:

4. Have students perform visual check of a tractor, record deficiencies and submit list.

5. Have students perform tune up according to tune up chart, TM 2.

VISUAL INSPECTION CHECKLIST

OIL AND WATER LEAKAGE

ELECTRICAL SYSTEM

- **Battery**
- **Cables**
- **Wiring**
- **Indicator Lights**

COOLING SYSTEM

- **Water in Crankcase**
- **External Leaks**
- **Clogging**

AIR INTAKE SYSTEM

- **Air Leaks**
- **Restrictions**

FUEL SYSTEM

- **Leaks**
- **Restrictions**
- **Clogged Filter**

STEAM CLEANING

ENGINE TUNE UP

TN-2

<i>Step No.</i>	<i>Operation</i>	<i>Step No.</i>	<i>Operation</i>
	1. AIR INTAKE AND EXHAUST SYSTEM		3. IGNITION SYSTEM (Spark-Ignition Engines)
<input type="checkbox"/>	Clean out pre-cleaner (if used)	<input type="checkbox"/>	Spark Plugs Clean and adjust gap
<input type="checkbox"/>	Remove and clean air cleaner	<input type="checkbox"/>	Check spark plug wires
<input type="checkbox"/>	Inspect exhaust system and muffler	<input type="checkbox"/>	Distributor Check the following items:
<input type="checkbox"/>	Check crankcase ventilating system for restrictions	<input type="checkbox"/>	Cap and rotor
<input type="checkbox"/>	Check intake manifold for leaks	<input type="checkbox"/>	Breaker points
<input type="checkbox"/>	Check air intake for leaks or restrictions	<input type="checkbox"/>	Breaker point gap
<input type="checkbox"/>	Check radiator for air bubbles or oil indicating compression or oil leakage	<input type="checkbox"/>	Cam lubrication
<input type="checkbox"/>	Check cylinder head gasket for leaks	<input type="checkbox"/>	Distributor timing
<input type="checkbox"/>	Retighten cylinder head cap screws		4. COOLING SYSTEM
<input type="checkbox"/>	Adjust valve tappet clearance	<input type="checkbox"/>	Check water pump for leaks and excessive shaft endplay
<input type="checkbox"/>	Check engine compression	<input type="checkbox"/>	Inspect radiator hoses
	2. ELECTRICAL SYSTEM	<input type="checkbox"/>	Clean and flush cooling system
<input type="checkbox"/>	Battery Check the following items:	<input type="checkbox"/>	Test thermostat operation
<input type="checkbox"/>	Clean battery, cables and terminals	<input type="checkbox"/>	Check radiator for leaks
<input type="checkbox"/>	Tighten battery cables and battery hold-down clamps	<input type="checkbox"/>	Check condition of fan belt
<input type="checkbox"/>	Coat battery posts and cable clamps with petroleum jelly		5. FUEL SYSTEMS
<input type="checkbox"/>	Check specific gravity of electrolyte and add water to proper level	<input type="checkbox"/>	Check fuel lines for leaks or restrictions
<input type="checkbox"/>	Generator or Alternator Check belt tension	<input type="checkbox"/>	Clean fuel pump sediment bowl
		<input type="checkbox"/>	Clean fuel strainer or filter
		<input type="checkbox"/>	Check radiator for LP-Gas leaking from converter into cooling system
		<input type="checkbox"/>	Drain sediment from gasoline or diesel fuel tank
		<input type="checkbox"/>	Bleed diesel fuel system
		<input type="checkbox"/>	Carburetor adjustments
			6. LUBRICATING SYSTEM
		<input type="checkbox"/>	Check operation of pressure gauge or light
		<input type="checkbox"/>	Drain and refill crankcase
		<input type="checkbox"/>	Replace oil filter
			7. CLUTCH PEDAL FREE TRAVEL
		<input type="checkbox"/>	Check free travel at clutch pedal

General References

Fundamentals of Machine Operation, Tractors, John Deere service publication.

F.M.O. Preventive Maintenance, John Deere Service publication.

Machines for Power Farming, Stone and Gulvan.

Principles of Farm Machinery, Bainer, Kepner, Borger.

Operation, Maintenance, and Repair of Farm Machinery, John Deere

Tractors and Crawlers, Frangee, Bedell.

Daily Operation and Maintenance, VEP

Operators Manuals.