

Outdoor Power Equipment Technician

Study Guide



Turf Equipment

Final Period and Qualification Exam

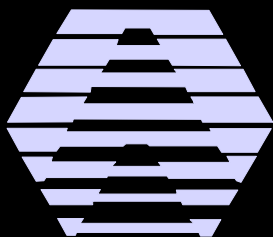


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SECTION ONE: TOPIC FLOW CHARTS

CUTTING UNITS

Mowing	Golf course	Parks	Residential
Sharpeners	Relief Grinding	Spin Grinding	Rotary Blade Sharpeners
	Back lapping	Bed knife Maintenance Tools	
Reel Mowers	Reel	Bed knife	Rollers
	Shields	Set-up Procedure	
Rotary Mowers	Clipping Dispersal Decks	Mulching Decks	Blade Drives
	Blade Types	Set-up	
Flail Mower	Flail Drive Types	Blade Types	Set-up

Hydraulic Systems

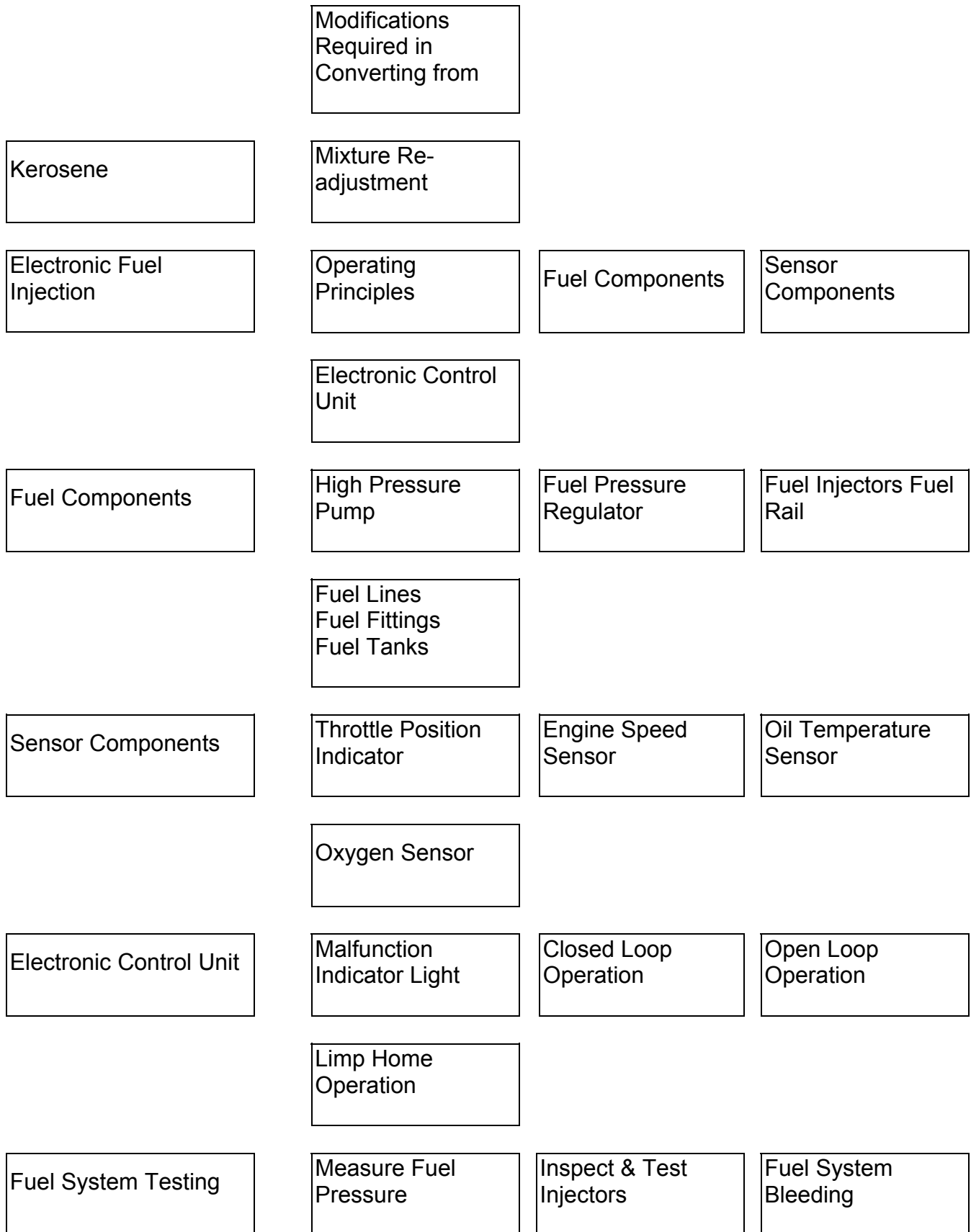
Hydraulic Principles	Fluid	Laws & formulas	Advantages & Disadvantages
	Basic system		
Pumps	Piston	Gear	Vane
	Theory of Operation	Repair Techniques	
Valves	Directional Control	Flow	Pressure
	Sequence	Priority	
Actuators	Motor	Cylinders	Accumulators
	Theory of Operation	Repair Techniques	
Problem Diagnostics	Test Equipment	Hydraulic Connections	Safety

Electrical Systems

Electrical Basics	OHMS law	Calculate Electrical Power	Multimeter Function
	Series Function	Parallel Circuit	Circuit Test Procedure
Starting System	Batteries	Starters	Fuel Shut off
	Interlock Switches	Delay Switches	
Charging	Battery	Starters	Fuel Shut off
	Interlock Switches	Delay Switches	
ECU	Inputs	ECU Types	Outputs
	Diagnostic Procedures		

Diesel Engine Overhaul (Advanced Fuel Systems)

Engine	Pistons & liners	Crankshafts	Valve train & Overlap
Low Pressure Fuel system	Fuel Tank	Lines & Connections	Primer Pumps
	Electric Pumps	Diaphragm Pumps	
High Pressure Fuel System	Pump Types	Pump Timing	Delivery Valves
	Fuel Lines	Fuel Injector Types	Injector Tests
System Troubleshooting	Fuel System bleeding Procedure	Over fueling (rich)	Lean Mixture
	Cylinder Cancellation Test		
Alternate Fuels	Liquid Propane Gas	Kerosene	Components of Each
	Operating Principles		
LPG	Problem Diagnosis	Adjustment Procedures	Safety Concerns



Safety Precautions

Sensor Testing

Connectors &
Grounding

Resistance
Measurements

Voltage
Measurements

MIL Operation

System Writing

Battery Connect

Power Carts

Engines	Two and Four Stroke Engines	Fuel Systems	Ignition Systems
	Service and Adjustments		
Power Train	Primary Torque Converter	Transaxle	Governor
	Brakes		
Electrical Circuits	Starting	Charging	Interlock
	Accessories		
Electrical Carts	Batteries	36 & 48 Volt Systems	Charging Systems
	Cart Barn Set-up		
Steering	Worn Gear	Rack and Pinion	Front End Adjustments
	Tires		

Sprayers

Spray Components	Tanks	Pumps	Spray Circuits
	Regulators and Gauges	Screens and Filters	Plumbing
	Nozzles		
Operating	Calibration	Loading Sprayer	
Storing	Cleaning	Winterizing	

Irrigation

Hydraulic Fundamentals	Pressure Conversion	Friction Loss	Flow Velocity
	H ² O Hammer		
Sprinkler Heads	Heads Types & Coverage	Pressure vs. Performance	Solenoid Valves
Valves and Controllers	Valve Types	Master controllers	Field Satellites
Plumbing	Piping	Fittings	Thrust Blocks
Pumping Systems	Types of Pumps	Pump Drives	Electric Motors
Basic System Design	Sizing	Power Requirement	Equipment Selection
System Maintenance	Operational Maintenance	Start-up	Winterization

SECTION TWO: TOPIC OBJECTIVES**General** (from periods 1, 2, 3)

1. Understand the basic laws of electricity and be able to wire, diagnose and calculate values for the various circuits used in a marine application.
2. Know the types and proper use of precision measuring tools.
3. Describe the principles of hydraulic power transmission.
4. Describe the operation of a hydraulic system.
5. Describe the components of a typical hydraulic system.
6. Describe and troubleshoot the various cooling systems used in turf equipment engines.
7. Know the various engine designs, their advantages, disadvantages and the applications where they may be used.
8. Describe the operation of the diesel and gasoline engines.
9. Describe the purposes of exhaust systems, including turbocharging.
10. Know the typical service procedures for both diesel and gasoline engines.
11. Diagnose and describe failures to bearings and seals as well as understand the operation and placement of the various bearings and seals.
12. Describe the operation of a lead acid battery and the methods used to safely service and maintain the battery.
13. Describe the various starting and charging systems in use and the problems that may arise as a result of failures to any of the systems components.
14. Know P.D.I. procedures for turf equipment.
15. Describe the proper setup and service procedures for turf cutting equipment.

Practice Questions

16. What is Ohm's law?
17. What are the three measurements that a vernier calliper can measure?
18. How would you troubleshoot a non functioning hydrostatic drive?.
19. Why does an overhead cam engine have a higher maximum R.P.M. than a push rod engine?
20. What is valve float?
21. What is the difference between supercharging and turbocharging?
22. What is the source of combustion in a diesel engine?.
23. What is the purpose of the swash plate in a hydraulic system?

NOTES

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24. What steps would you take to diagnose a non running engine?
 25. What three things are required to produce electrical energy mechanically?
 26. What is the diode trio and what function does it serve in a charging system?
 27. What will the voltage drop test tell you about the starting circuit of an engine?
 28. How does the commutator and brushes of a starter motor change the direction of current flow in the armature of the starter motor?
 29. How is reel mower clip calculated?

CUTTING UNITS

Define the different grass types as well as mowing area.

Understand the differences between Spin Grinding and Relief Grinding as pertained to a reel type mower.

Reel back lapping procedures on and off the machine as well as types of lapping compounds.

Evaluate a poor quality of cut.

Explain the different rotary blade sharpening techniques.

Reel & Rotary mower set-up adjustments.

Define Rate of Clip (Reel & Rotary) (calculation).

Understand the purpose of the two ground surfaces on a bed knife.

Define the parts of a Reel & Bed knife Cutting Unit.

Compare effective HOC to bench setting, height of cut.

Define the different roller types (reels) and their function.

QUESTIONS:

1. How would a thatchy turf area affect the reel mower's height of cut?
2. What is the correct rotary blade grind angle?
3. Define the term "blade thinning" as pertained to a reel blade.
4. What is the difference between top face angle on a Toro Bed-knife vs. a Jacobsen or John Deere Bed-knife?
5. List three ways a reel blade can be attached to a reel spider (support).
6. Describe what is meant by the term "bedknife attitude".
7. Compare reel rpm to grinding stone rpm when spin grinding a reel mower.
8. How does a decreased traction speed affect reel mower cutting performance?
9. What is the purpose of backlapping after relief grinding a reel?
10. What would cause "coning" of a reel?

HYDRAULIC SYSTEMS

Understand principles of flow, pressure, hydraulic formulas and hydraulic measuring devices.

Understand and describe closed and open loop systems.

Know the different directional control valves and how they are actuated.

Understand the role of the different circuit relief valves.

Diagnose hydraulic problems, i.e., parallel and series hook-ups.

Understand how and why hydrostat swash plates are actuated.

Describe the different hydraulic fittings used in compact equipment.

Explain the different hydraulic seal types and installation procedure.

QUESTIONS

1. Explain how an inlet line restriction would effect actuator performance. How many amps of power are required to open an electric over hydraulic directional control valve?

List the different cushioning systems used in Hydraulic Cylinder Actuators.
What happens to hydrostat performance if the charge pump inlet is restricted?
What is the purpose of an accumulator in a Hydraulic System?
How is hydraulic motor torque increased?
How would a weak pressure relief valve effect hydraulic cylinder performance?
What method is used to clean a Sticky Directional Control Valve?

ELECTRICAL

Understand battery operation and test procedures.
Be able to apply Ohm's Law and calculate electrical power when system diagnosing.
Understand the function of the computer on turf equipment (inputs vs outputs).
Know the operation and function of interlock or safety circuits.
Understand the different types of fuel start solenoids.
Understand internal and external alternator operation.
Understand the operation of a DC type motor.
Understand DC generator principles with charge coil.
Voltage regulator operation and test procedures.
Operation and test procedures for different start solenoids (DC).
Understand multimeter operation and different functions.

QUESTIONS

1. List the common inputs and outputs used by the E.C.U. on most turf equipment. The engine "stops" when the PTO is engaged on a fairway mower. What interlock switch is at fault? (*operator on seat*).

Can a voltage drop be performed on a diode to diagnose its performance?
How would a worn flywheel key effect the Ignition System? (flywheel magneto system)

5. How does engine rpm effect generator output?
6. What is the proper test procedure for a *Hall* effect speed sensor.
7. Explain how an alternator output test is performed.
8. List the probable causes of a high DC motor starter draw test.

Compare the interlock circuits between a lightweight fairway mower and a rotary mower.

DIESEL (ADVANCED FUEL SYSTEMS)

Describe cylinder liner types and replacement techniques.
Understand fuel governor type and function.
Know basic high-pressure fuel, circuit and test points (bleed points)
Understand and identify the different high-pressure fuel pumps.
Know the different compression ignition injector types and test procedures.
Understand the different pre-combustion chamber designs and their function.
Diesel fuel filtering systems, grades of fuel, fuel storage.
Understand pre-heat engine start system and troubleshooting.

Understand the different injector pump timing procedures.
Understand cylinder compression tests, cylinder leak down tests and air intake lead down test procedures.
Turbos – function, types, lubrication, systems.
Be familiar with EFI operating principles, components and function of each.
Be able to identify, remove and replace all EFI components and sensors.
Understand how malfunctioning EFI sensors affect the running characteristics of the engine.
Be familiar with testing procedures pertaining to all EFI sensors.
Know how to test fuel pressure on EFI system.
Be familiar with operating principles, components and adjustment of LPG fuel systems and related engine components.
Be aware of safety concerns when working on or adjusting LPG systems.
Be able to connect test equipment required for LPG system adjustment.
Be aware of running characteristics and any engine/ignition modification required when using kerosene as a fuel.

QUESTIONS:

Name and Describe three tests normally performed on fuel injector nozzles.
What is the purpose of the pre-combustion chamber?
List in the proper order the steps in bleeding a starved high pressure fuel injection system.
Describe the term “spill timing” as referred to in a high pressure fuel system.
How would a service technician diagnose a loose delivery valve?
How does the engine governor control the high pressure fuel pump?
How would a leaky injector effect engine performance?
Why is a water separator so important in a compression ignition engine’s fuel supply?
Explain how the air/fuel mixture is controlled on EFI engines.
What problems or conditions might cause a rich running condition at all speeds?
What controls fuel pressure to the injectors on EFI engines?
Where is the TPI located?
Explain how the ECU operates.
How is mixture strength controlled/adjusted on LPG equipped engines?
Are there any engine/ignition modifications required if switching from gasoline to kerosene fuel?

POWER CARTS

Know the different front wheel adjustments performed on power carts.
Understand different DC starting and charging circuits.
Define brake system components and adjustments.
Understand different battery types, as well as test procedures.
Identify different starting circuit interlock systems.
Know primary and secondary clutch function and overhaul procedures.
Diagnose spark ignition, engine ignition problems and component features.
Understand 36 and 48-volt charger components and test procedures.

Know interlock switch types and their functions.

QUESTIONS:

Explain how camber is adjusted in club car golf carts.

What is the minimum brake pad thickness on most golf cars with mechanical brakes?

Define "sulphation" as pertaining to golf cart batteries.

Why are 48-volt systems used/preferred rather than a 36-volt power pack?

What is the purpose of a shunt winding found in the starter generator?

Describe governor operation found in golf cart transaxles.

Battery specific gravity should be corrected to what temperature?

What would cause commutator pitting in a starter generator?

SPRAYERS

1. Identify sprayer types and their operations:

Hand operated sprayers

Low pressure field sprayers

High pressure utility sprayers

Know all sprayer components, their functions, location and test procedures.

Calculate and evaluate sprayer calibration.

Describe the different sprayer loading, cleaning and storing procedures.

Questions:

Why does a centrifugal pump work well for golf course sprayers?

How would you increase the litre/hectare of solution out of the spray boom?

Why are spray tanks **not** square shaped with a flat bottom?

4. List three types of tank agitation found in sprayers.

5. Explain how you would perform a pump capacity check.

If you calibrate your sprayer to travel at 7 km/hour, how many seconds should it take to travel 140 meters?

IRRIGATION

1. Understand hydraulic fundamentals; i.e. pressure conversion, friction loss, flow velocity and water hammer.

2. Know the different types of sprinkler heads, their operation, coverage, pressure vs. performance and solenoid valves.

3. Know irrigation valve and controller types, their function and operation.

4. Understand basic irrigation design, sizing, power requirements and equipment selection.

5. Compare pump types to Irrigation design and practicality.

6. Know system start-up and winterization techniques performed on Irrigation systems.

Questions:

Explain how thermal expansion affects plastic pipe that is installed in the ground?

Why must polyethylene pipe have a constant inside diameter?

Why are gate valves used as isolation valves?

Centrifugal pumps use a packing type of seal. When should this seal be replaced?
How is rotation of a gear driven rotary sprinkler accomplished?
6. What determines pop-up sprinkler installation depth?

Book List

John Deere Shop Tools
John Deere Fasteners
John Deere Belts and Chains
John Deere Bearings and Seals
John Deere Engines Compact Equipment
John Deere Fuels, Lubricants and Coolants
Briggs and Stratton Service Manual
Alfred C. Roth, Small Gas Engines
John Deere Power Trains Compact Equipment
John Deere Hydraulics Compact Equipment
John Deere Electrical Systems
Welding Notes (Gas and Arc)
Guide to Crop Protection in Alberta – Part III
Pesticide Application Equipment
Tee Jet Spray Products – Catalogue #46



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