Marine Electronic Engine Application Review

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MARINE APPLICATION REVIEW

The purpose of doing an application review is customer satisfaction. Customer satisfaction is directly related to the proper engine application in the end product. Proper engine installation is the best way to ensure repeat sales, optimum product reputation and reduced warranty claims.

To minimize installation issues, follow the John Deere Application Guidelines, perform engine application tests and complete the appropriate Marine Engine Application Review forms.

Deere cannot guarantee that engines have been properly matched to give desired vessel performance. Vessel performance is impacted by characteristics of the hull and entire propulsion system, including the engine power, marine gear ratio, propeller diameter and pitch, hull shape and even the geographic location in which the vessel operates. Therefore, John Deere cannot guarantee vessel performance. Information on correct engine selection is provided in a separate guideline.

Note: Marine application reviews should follow the instructions contained in the application review section of this guideline. This review procedure does not include provisions for testing radiator-cooled installations. Reviews of marine applications that use a radiator-type cooling system should use the industrial application review guidelines.

SEA TRIALS

The sea trial is part of the marine application review process. The application review process begins during the first engine selection discussion with a customer. It concludes with a Sea Trial; the performance check of the completed engine installation. During the sea trial, vessel information is gathered and verified, the engine installation is reviewed and engine performance data is recorded. It is important to note that the sea trial procedure outlined in this guideline is not a measure of the seaworthiness of the vessel; it is only a check of the engine installation.

This application review procedure is designed as a step-by-step process to be followed for each marine engine installed.

APPLICATION REVIEW PROCEDURE

The first step in an engine installation is gathering information about the vessel and current equipment (if this is a repower). If this data was not collected at the time the engine was sold to the customer, collect it at the time of the application review.

Vessel - For propulsion engines only
Record the information on the vessel's manufacturer, model and hull number. The length, beam, draft and weight should also be recorded along with the hull type and material. Other required information is the application type (pleasure vs. commercial) and propulsion system.

Previous Engine and Gear - Repowers only
Customers often request assistance in sizing propulsion system components. When applicable, record the previous engine and accompanying data. This information is often requested by propulsion system suppliers.

Engine
Record the engine model, serial number and power rating selected. The rating can be found by looking up the Performance Option Part Number or the Factory Option number on the Marine Performance Option Codes spreadsheet. The part numbers can be found using Service Advisor.

Marine Gear
Record marine gear manufacturer, model and reduction ratio. Also note if it is an electrical or mechanical shift and the type of trolling valve, if any, is present. At the time of the sea trial, record the serial number of the gear.

Propeller
Record propeller manufacturer, style, diameter, pitch and number of blades.

Other Propulsion System Information
Note if the vessel has any special or unique propulsion equipment such as a Kort Nozzle, stearable nozzle, Z-Drive, Arneson surface drive, Aquadrive, jet drive, tunnel drive or surface piercing propeller.

Powered Components
Record all components (not installed at the factory) that will be driven by the engine. Attach mass elastic data for gen set engines.

Visual Inspection

Before conducting any performance tests, take a few moments to inspect the vessel and engine installation. Use this time to record any information concerning the vessel, engine, or transmission that was previously left blank.

Engine Mounting

- Measure the engine installation angle. Remark dispstick if necessary using the instructions provided in the Oil System guideline.
- Ensure all connections to the engine (excluding driveline) are flexible.

Lubrication System

- Record any additional components that have been added to the lubrication system.

Air Intake System

- Note the airflow path to the engine.
- Engine room ventilation fans should be exhaust fans which add to the air flow into the engine room created by the engine. Record ventilation fan flow capacity.

Fuel System

- Review the fuel connections to the engine to verify proper line sizes.

Electrical System

- Record components engaged during cranking, such as hydraulic and bilge pumps.
- Verify that the engine is grounded to the vessel bonding strip. (For wood or fiberglass vessels only. A bonding strip is not required on steel, aluminum or any other type of metal hull.)

Cooling System

- Record requested information for any coolant recovery (overflow) or remote expansion tanks in use. Make sure cap style matches the type of system in use; Need a dual-action for a recovery system and a single-action for overflow only.
  Note: A recovery tank is not the same as overflow.
- Keel cooled engines require a cooling system test to verify the performance of the keelcooler.
- On heat exchanged engines, check sea water pump inlet pressure during the sea trial.

Sea Trial

The final step in the application review process is to record engine and vessel performance data. The best time to record this information is when the boat is launched.

INSTRUMENT THE ENGINE

Before the sea trial test, review the installation to confirm proper engine oil and coolant levels. Install instrumentation required for the test. On electronic engines, connect DST or Service Advisor to the ECU of the engine being tested to obtain sensor-measured values.

The ECU and instrument panel may be used to record the values for the following test parameters:

- Engine Speed
- Percent Load
- Fuel Rate
- Coolant Temperature
- Oil Pressure
- Air intake manifold temperature (4045TFM75, 6068TFM75/76, 6068SFM50/75, 6125SFM75)

In addition to the information that can be extracted from the ECU using DST or Service Advisor, some additional measurements are also required. This information is required regardless of the cooling system used.

- Boost pressure - manometer or other pressure reading device. Port in intake manifold.
- Exhaust temperature - Measure at 1/8" NPT port on John Deere exhaust elbows. If a John Deere exhaust elbow is not used, per EPA requirements, there must be a tapped 1/8" to 1/2" NPT port located in the dry section of the elbow.
- Exhaust back pressure - Measure at 1/8" NPT port on John Deere exhaust elbows. If a John Deere exhaust elbow is not used, per EPA requirements, there must be a tapped 1/8" to 1/2" NPT port located in the dry section of the elbow.
- Ambient air temperature - Measure with thermocouple or temperature probe on deck.

For keel cooled engines, the following information is also required in addition to the items above:

- Sea water temperature - thermocouple or probe in water overboard
- Keel cooler inlet and outlet temperature - Measure at zinc anode locations in expansion tank on 4045 and 6068 marine engines. Keel cooler inlet temperature on the 6081 and 6125 engines, between the thermostat housing cover and the keel cooler inlet. Keel cooler outlet temperature on the 6081 and 6125 engines, between the keel cooler outlet and water pump inlet.
- Keel cooler inlet and outlet pressure - Measure at zinc anode locations in expansion tank on 4045 and 6068 marine engines. Keel cooler inlet pressure on the 6081 and 6125 engines, measure between the thermostat housing cover and the keel cooler inlet. Keel cooler pressure on the 6081 and 6125 engines, measure between the keel cooler outlet and water pump inlet.
- Water pump inlet pressure - 6081 and 6125 engines, the location is the same as the keel cooler outlet pressure.

For heat exchanger cooled engines, the following information is required in addition to the information above:

- Sea water pump inlet restriction - 6068SFM (1/4” NPT), 6081 (1/8-27 NPT), and 6125 (1/4” NPT) engines have a tapped hole on Sherwood inlet elbows.
- Sea water pump discharge pressure - 6068SFM (1/4” NPT), 6081 (1/8-27 NPT), and 6125 (1/4” NPT) have a tapped hole on Sherwood outlet elbow.

PROPULSION ENGINES

One aspect verified during the sea trial is the engine operating speed. The propellers must be sized to allow the engine to run at the appropriate operating speed and load during normal operating conditions. The boat should be loaded with a full supply of fuel, water, supplies, and passengers (or equivalent weight) to insure an accurate measure of boat performance.

It is important to make sure that the temperatures and pressures stabilize at each data point before recording the data. The test procedure used will vary based on the type of application.

Propulsion engine tests should be conducted under maximum load conditions for the engine. The appropriate tests for the type of boat operation should be performed. Do not conduct any tests which may damage the boat. Speed measurements should be taken in two directions, 180° from each other, in order to have an average run.

For all engine ratings not intended for extended Bollard (Dead Shove) operation:

The maximum full-load operating speed is 40 rpm above the published rated speed.

For Water Jets:

Jets should be sized to allow the engine to obtain not-less-than rated speed. When calculating impeller size it is important to account for parasitic losses. A parasitic loss is caused by a component which consumes a portion of the engines energy, such as an alternator, sea water pump, auxiliary pumps, marine gear and drive line, etc. If the exact quantity of parasitic energy loss is unknown, a good “rule-of-thumb” is to assume the loss will be 5 percent of bare engine power.

For example, for a typical engine installation with rated power of 400 HP @ 2800 RPM, this “rule-of-thumb” can assume that the parasitic loss is 5%, or 20 HP (400 HP x .05). In this example, the impeller should be sized to absorb approximately 380 HP (400 - 20 = 380 HP) while allowing the engine speed to reach 2800-2825 RPM at full throttle.

Note: During sea trials the engine may not reach rated speed if the 100 hour break-in service has not yet been performed. Engine speed at full throttle should be confirmed with the customer after: 1) 100 hours of engine operation and 2) break-in service has been performed.

Fixed Pitch, Submerged Propellers:
The engine must obtain at least 25 rpm above rated speed with the vessel in the customer's fully loaded condition with the customer's operating supplies, a clean hull bottom and clean and damage-free props. However,

- For sea trials conducted before the vessel is 100% complete, the engine must achieve 40 rpm above rated speed with less than 100% engine load. The result from this test is a provisional acceptance of the prop dependent on follow-up sea trial results with correct (or correctly simulated) maximum load, in-service conditions.
- For sea trials of 100% complete vessel in "customer delivery condition" the RPM may be less than 40 rpm above rated speed but not less than 25 rpm above rated speed at 100% load.
- For vessels intended for occasional, short duration Bollard operation, the engine must obtain between rated speed and 40 rpm above rated speed under bollard conditions.
- The owner may operate the vessel until the engine RPM drops below 50 rpm less than rated speed, at which time maintenance is required (hull bottom cleaned, prop repair, etc.)

For engines intended for Bollard (Dead Shove) operation:

- The engine must be within 100 rpm of rated speed under bollard conditions.

Test Procedure - Free Running

1. Instrument engine
2. Warm up engine prior to conducting the test. This will ensure accurate readings during the test.
3. Begin recording data at 1000 rpm. Allow the temperatures and pressures to stabilize before recording the measurements.
4. Increase speed in 100 rpm increments recording information as indicated in the Marine Application Review program. Measurements outside the acceptable range will be flagged.
5. Continue to increase speed until the throttle is wide open. Record maximum engine speed. This should be within the limits described above.
6. Reverse boat direction and follow the same procedure.
7. Review data to ensure that all measurements are within acceptable levels. Make necessary corrections to the system to bring all values within the acceptable levels.
8. If necessary, repeat test to verify corrections have fixed the problem.
9. Congratulations!!! You have completed the sea trial portion of the application review.

Test Procedure - Bollard Pull or Push (Dead Shove)

Note: If possible, conduct test in a location with at least 10 feet (3 meters) of water depth below the keel of the vessel. In shallow water, the water recirculation increases water flow into the propeller which decreases propeller load. Vessels that normally "push" a load should do a Push Test against a dock or other fixed structure. Vessels that normally tow a load or nets behind the vessel should do a Pull Test with a line or cable running from the vessel to a bollard on the dock.

1. Instrument the engine.
2. Warm up engine prior to conducting the test. This ensures accurate readings during the test.
3. Begin recording data at 1000 rpm while pushing against the bank or dock. Once temperatures and pressures stabilize, record the necessary information.
4. Increase engine RPM in 100 rpm increments recording information as indicated in the Marine Application Review program. Measurements outside the acceptable limits will be flagged.
5. Continue to increase speed until the throttle is wide open. Record maximum speed. It should be within the limits described above.
6. Make necessary corrections to the systems to bring any measurements that are outside the acceptable limits into range.
7. If necessary, repeat the test to verify that corrections have fixed the problems.
8. Congratulations!!! You have completed the sea trial portion of the application review.

GENERATOR ENGINES

Once generators are installed in the vessel, the operating performance should be checked to verify performance and operating conditions. Generator sets should be run under maximum steady-state electrical load anticipated with the vessel stationary at the dock.

Details on generator engine basic and selection criteria can be found in AG-21. Marine gen sets typically operate as prime power units.

If possible, use a load bank to verify load pick-up and performance at various conditions.

Test Procedure - on board - no load bank

1. Instrument the engine.
2. Warm up engine prior to conducting the test. This ensures accurate readings during the test.
3. Fully load engine with the highest load possible. Record measurements.
4. Make necessary corrections to the systems to bring any measurements that are outside the acceptable limits into range.
5. If necessary, repeat the test to verify that corrections have fixed the problems.
6. Congratulations!!! You have completed the sea trial portion of the application review.

Test Procedure - load bank

1. Instrument the engine.
2. Warm up engine prior to conducting the test. This ensures accurate readings during the test.
3. Load engine to 25% load. Record measurements.
4. Increase load to 50%. Record measurements.
5. Increase load to 75%. Record measurements.
6. Increase load to 100%. Record measurements.
7. Increase load to 110% (only for Prime Power ratings).
8. Values should be within the limits on the performance curves for all test points.
9. Make necessary corrections to the systems to bring any measurements that are outside the acceptable limits into range.
10. If necessary, repeat the test to verify that corrections have fixed the problems.
11. Congratulations!!! You have completed the sea trial portion of the application review.

KEELCOOLER SYSTEM TEST

This test should be done to verify that the keel cooler is adequately sized for the engine power.

Test Procedure

1. Record sea water temperature.
2. Warm up engine prior to conducting the test. This ensures accurate readings during the test.
3. Run the engine at full load conditions until coolant temperatures stabilize.
4. Measure keel cooler outlet temperature.
5. Determine maximum sea water temperature. Calculate the temperature difference between the maximum temperature and the current sea water temperature.
6. Add the sea water temperature difference to the keel cooler outlet temperature. If the new value is less than 212° F (100° C) then the keel cooler is adequately sized for the engine. If the value is more than 212° F (100° C) then the keel cooler is not large enough for the engine.
7. Measure the keel cooler inlet and outlet pressure. The pressure difference should be less than 6 psi (40 kPa) for propulsion engines, 4 psi (28 kPa) for 1800 rpm ratings and 3 psi (21 kPa) for 1500 rpm ratings.

History of Changes

Date	Section Owner	EIB	Page(s)	Description of Change(s)
09 May 29	Nathan Stabile	- - - -	AG-25.5 - 4; All pages	• Additional detail added under **"For Water Jets" to compensate for parasitic losses.** • On all pages, heading changed to "Marine Electronic Engine Application Review."
12 Dec 11	Nathan Stabile		AG-25.5 - 5	Under "For engines intended for Bollard (Dead Shove) operation:" the stated speed range was changed to 100 rpm.