

Leisure Marine and Small Engine Lubricants

- ◆ Recertified NMMA TC-W3[®] Mercury 15HP Detergency
- ◆ Recertified NMMA TC-W3[®] OMC 40 HP General Performance Procedure
- ◆ Recertified NMMA TC-W3[®] OMC 70 HP Detergency
- ◆ Recertified NMMA TC-W3[®] Lubricity Procedure
- ◆ Recertified NMMA TC-W3[®] Pre-Ignition Procedure
- ◆ Recertified NMMA TC-W3 AF-27 Lubricity Procedure
- ◆ NMMA FC-W 115-HP General Performance Engine Procedure
- ◆ JASO Lubricity
- ◆ JASO One-Hour Detergency and CEC L-79-T-97 3-Hour Detergency Procedure
- ◆ JASO Smoke
- ◆ JASO Exhaust System Blocking
- ◆ ASTM Yamaha Y-350M2 Ring Sticking and Deposit Procedure
- ◆ ASTM Yamaha Lubricity Procedure
- ◆ ASTM Yamaha Pre-Ignition Procedure

Recertified NMMA TC-W3[®] Mercury 15 HP Detergency

Specifications

NMMA TC-W3[®].

Objective

To evaluate the lubricant's ability to prevent piston ring sticking, cylinder scuffing and seizure in two-stroke cycle outboard engines designed to run at fuel/oil ratios up to 100:1.

Field service simulated

Two-stroke cycle outboard engine service is simulated.

Procedure fixture

A Mercury 15HP 16 cubic inch, two-stroke cycle, water-cooled, spark ignition, outboard engine is used. A closed coolant system maintains engine temperature and a special load wheel replaces the propeller to obtain proper rpm at WOT. Complete engines are mounted in specially designed outboard procedure tanks.

Procedure parameters

The procedure is conducted for 100 hours on a 55-minute wide-open throttle, 5-minute idle cycle with a 1-hour soak and compression check period after each 10 hours of running time. The following conditions are maintained:

Engine, rpm WOT	5500
Coolant out temperature, °F	130 (54.4°C)
Fuel flow, lb/hr	10-13

Procedure parts evaluated

General engine condition with particular emphasis on pistons, rings, and cylinders is evaluated.

Used lubricant analysis

None.

Pass/fail criteria

The pass/fail criteria are as follows:

- No compression loss of 20 PSI or greater within 100 hours of procedure operation.
- Piston scuffing limited to 15% circumferential
- Ring wiping limited to 5%.
- The piston pin needle bearing must fall easily from the bore of the wrist pin.
- Average adjusted second ring sticking must be greater than or equal to 8.0 merits.
- Average piston second land deposits must be greater than or equal to 6.0 merits.
- Two consecutive or concurrent passes must be obtained on the Mercury 15HP procedure for new formulation or formulations that do not meet read-across guidelines.

Recertified NMMA TC-W3[®] OMC 40 HP General Performance Procedure

Specifications
NMMA TC-W3[®].

Objective

The objective of this procedure is to evaluate the general performance of lubricants for application in two-stroke cycle outboard engines designed to run at fuel/oil ratios up to 100:1. Piston varnish, ring sticking, and general engine deposits are the primary evaluation areas.

Field service simulated

Two-stroke cycle outboard engine service is simulated.

Procedure fixture

An OMC 40 HP, 45 cubic inch, two-stroke cycle, water-cooled spark ignition, outboard engine with specially designed pistons and rings. A closed coolant system maintains engine temperature and a special load wheel replaces the propeller to obtain proper rpm at WOT. Complete engines are mounted in 1700-gallon procedure tanks.

Procedure parameters

The procedure is conducted for 98 hours on a 55-minute wide-open throttle, 5-minute idle cycle with a 1-hour soak period after each 7 hours of running time. The following conditions are maintained:

Engine, rpm WOT	4500
Coolant out temperature, °F	170 (76.7°C)
Fuel flow, lbs/hr	21.5
Fuel/oil ratio	100:1

Procedure parts evaluated

General engine condition with particular emphasis on pistons and rings is evaluated.

Used lubricant analysis

None.

Pass/fail criteria

Piston varnish, ring sticking, and general engine deposits are the primary evaluation areas. As good or better than NMMA 93738 reference oil within the specified tolerance in the areas of top ring sticking and average piston deposits are the pass/fail criteria.

Recertified NMMA TC-W3[®] OMC 70 HP Detergency

Specifications
NMMA TC-W3[®].

Objective

The objective of this procedure is to evaluate the general performance of lubricants for application in two-stroke cycle outboard engines designed to run at fuel/oil ratios up to 50:1. Piston deposits and ring sticking are the primary evaluation areas.

Field service simulated

Two-stroke cycle outboard engine service is simulated.

Procedure fixture

An OMC 70 HP 56 cubic inch two-stroke cycle, water-cooled, spark ignition, outboard engine is used. A closed coolant system maintains engine temperature and a special load wheel replaces the propeller to obtain proper rpm at WOT. Complete engines are mounted in 1700-gallon procedure tanks.

Procedure parameters

Following a 2-hour break-in, the procedure is conducted for 98 hours on a 55-minute wide-open throttle, 5-minute idle cycle. The following conditions are maintained:

Engine, rpm WOT	5000
Coolant out temperature, °F	130 (56.7°C)
Fuel flow, lbs/hr	37.4
Fuel/oil ratio	50:1

Procedure parts evaluated

General engine condition with particular emphasis on pistons and rings is evaluated at the end of this procedure.

Used lubricant analysis

None.

Recertified NMMA TC-W3[®] Lubricity Procedure

Specifications
NMMA TC-W3[®].

Objective

The objective of this procedure is to evaluate the lubricity of a lubricant.

Field service simulated

All two-stroke cycle outboard engine service is simulated.

Procedure fixture

A Yamaha CE50S single-cylinder, air-cooled, two-stroke cycle, spark ignition engine is set up on a procedure bed and coupled to a high-speed 10 HP dyna-mometer. External cooling air is supplied to the engine by a variable delivery fan.

Procedure parameters

Each tightening begins with a stabilization period at the following conditions:

Engine, rpm	4000
Load	WOT
Spark plug gasket temperature, °F	338 (170°C)
Fuel/oil ratio	150:1

After stabilization, the cooling air is stopped and torque decrease is monitored as spark plug gasket temperature rises. Cooling air is restored when spark plug gasket temperature reaches 662°F (350°C). This procedure is repeated five times in each of two sets on both the reference and candidate lubricants.

Procedure parts evaluated

General engine condition is evaluated at the end of this procedure.

Used lubricant analysis

None.

Pass/fail criteria

The candidate mean torque drop must be less than or equal to (within the 90% statistical confidence limits) or less than that for the NMMA 3259 reference oil.

Recertified NMMA TC-W3[®] Pre-Ignition Procedure

Specifications
NMMA TC-W3[®].

Objective

The objective of this procedure is to evaluate the effect of a lubricant on pre-ignition caused by combustion chamber deposits.

Field service simulated

Typical two-stroke cycle air-cooled engines operated at full power are simulated.

Procedure fixture

A Yamaha CE50S single-cylinder, air-cooled, two-stroke cycle, spark-ignition engine is set up on a procedure bed and coupled to a high-speed 10-HP dyna-mometer. External cooling air is supplied to the engine by a variable delivery fan.

Procedure parameters

The procedure is run under the following steady-state conditions for 100 hours:

Engine, rpm	4000
Load	WOT
Spark plug gasket temperature, °F	392
Fuel/oil ratio	20:1

Procedure parts evaluated

General engine condition is evaluated at the end of the procedure.

Used lubricant analysis

None.

Pass/fail criteria

No more major pre-ignitions than occurred in the most recent reference procedure on NMMA 93738 reference oil.

Recertified NMMA TC-W3 AF-27 Lubricity Procedure

Specifications

NMMA TC-W3

Objective

The objective of this procedure is to enhance the ability to evaluate the lubricity of lubricating oils in two-stroke cycle gasoline engines using a refinement of the JASO M340-92 and TC-W3 CE-50 lubricity procedures.

Procedure Fixture

A modified Honda AF-27, type SK50MM, 50 cm³ air-cooled, single-cylinder, two-stroke cycle spark ignition engine is set up on a procedure bed and coupled to a high-speed 10 HP dynamometer. External cooling air is supplied to the engine by a variable delivery fan.

Procedure Parameters

A procedure is composed of four sets of five to seven "tightenings". A "tightening" consists of measuring the torque decrease as the spark plug gasket temperature increases from 200 degrees C to 300 degrees C. The first and third sets are conducted using XPA-3259 reference lubricant. The second and fourth sets are conducted using a candidate lubricant. The sets are then compared using a prescribed statistical analysis. Each set is preceded by a 30-minute preliminary operation period at the procedure conditions of:

Engine speed, rpm	4000
Spark plug gasket temperature, °C	160 (320°F)
Torque, Nm	WOT
Exhaust gas CO concentration, %	6
Fuel oil ratio	50:1

The cooling fan is then stopped. During the tightening, the torque and spark plug gasket temperature are carefully monitored. When the spark plug gasket temperature reaches 300°C (572°F) the cooling fan is restored, and the engine is allowed to cool while running. When the spark plug gasket temperature is 160°C (320°F) the engine is allowed to stabilize for five minutes before starting the next tightening. During this time, the exhaust gas CO₂ is checked according to specification. This operational cycle continues until three sets of five to seven tightenings per set are obtained.

Procedure parts evaluated

No procedure parts are evaluated.

Pass/Fail Criteria

The candidate mean torque drop must be less than or equal to the NMMA 3259 benchmark oil, using the 90% statistical confidence limits.

NMMA FC-W 115-HP General Performance Engine Procedure

Specifications

NMMA FC-W

Objective

This procedure evaluates the general performance of a four-stroke cycle water-cooled marine engine lubricant when subjected to fuel dilution levels above 7% during the course of operation.

Procedure Fixture

This procedure used a standard Yamaha 115-Hp four-stroke cycle water-cooled, spark ignition outboard engine. A trimmed propeller provides the load to obtain a specified engine speed at WOT. The complete engine is mounted in a 10,000-gallon procedure tank.

Procedure Parameters

The procedure is 110-hours and is comprised of three primary segments. A ten-hour cyclic break-in, ninety hours of cyclic endurance testing, and ten hours of steady-state wide-open throttle.

Engine rpm at WOT	6000
Coolant In temperature	60 degrees F
Coolant Out temperature	130 degrees F
Fuel flow lbs/hr	60

Procedure Parts Evaluated

Cam lobes, cam caps, cam journals, cam bearings, piston rings, pistons, connection rod bearings, cylinder bores, main bearings, and crank journal are evaluated at the end of the procedure.

Pass/Fail Criteria

The components must not have excessive wear or any damage such as scuffing, spalling, scoring, or ring wiping, and in general, must be comparable to or better than the results of the most recent reference procedure.

JASO Lubricity (M340-92)

Specifications

JASO and ISO categories.

Objective

The objective of this procedure is to evaluate the lubricity of lubricating oils used in two-stroke cycle engines.

Field service simulated

Two-stroke cycle gasoline engines such as motorcycle, utility, and outboard engines are simulated.

Procedure fixture

A Honda SK-50MM, 50 cm³ air-cooled, single-cylinder, two-stroke cycle spark ignition engine is set up on a procedure bed and coupled to a high-speed 10 HP dynamometer. External cooling air is supplied to the engine by a variable delivery fan.

Procedure parameters

A procedure is composed of three sets of five to seven piston tightenings. The first and third sets are conducted using Jatre 1 reference lubricant. The second set is conducted using the candidate lubricant.

Each set is preceded by a 30-minute preliminary operation period at the procedure conditions of:

Engine speed, rpm	4000
Spark plug gasket temperature, °C	160 (320°F)
Torque, Nm	WOT
Exhaust gas CO concentration, %	6
Fuel oil ratio	50:1

The cooling fan is then stopped. During the tightening, the torque and spark plug gasket temperature are carefully monitored. When the spark plug gasket temperature reaches 300°C (572°F) the cooling fan is restored, and the engine is allowed to cool while running. When the spark plug gasket temperature is 160°C (320°F) the engine is allowed to stabilize for five minutes before starting the next tightening. During this time, the exhaust gas CO₂ is checked according to specification. This operational cycle continues until three sets of five to seven tightenings per set are obtained.

Procedure parts evaluated

No procedure parts are evaluated.

JASO Lubricity – cont'd

Used lubricant analysis

None.

Pass/fail criteria

The lubricity index is calculated using the following formula:

$$\left[\frac{\text{(A total average value of corrected torque decreases values on the standard Jatre 1 reference oil)}}{\text{(An average value of corrected torque decreases values on candidate oil)}} \right] \times 100$$

A lubricity index < 100 indicates performance inferior to the reference oil.

To determine the indices for the classification, many two-stroke cycle oils from different parts of the world have been tested for their performance. Based on the procedure results, the indices for pass/fail limits for each category have been decided.

Oils in each category correspond to the following 2T oils:

- The "FA" grade corresponds to the oils that have the absolute minimum acceptable performance level for two-stroke engines.
- The "FB" & "EGB" grade corresponds to oils which have high performance in lubricity, but are non-low smoke type.
- The "FC" & "EGC" grade corresponds to oils typical of low-smoke type oils in the Japanese market.
- The "EGD" grade corresponds to the oils that have greater detergency performance as identified in proposed Draft International Standard 13738.

The pass/fail limits for each category are as follows:

	Minimum Lubricity Index
FA	90
FB, EGB, FC, EGC, EGD	95

JASO One-Hour Detergency (M341-92) and CEC L-79-T-97 3-Hour Detergency Procedure

Specifications

JASO and ISO categories.

Objective

The objective of this procedure is to evaluate piston ring sticking tendencies and engine inside cleanliness at high temperature for lubricating oils used in two-stroke cycle engines.

Field service simulated

Two-stroke cycle gasoline engines such as motorcycle, utility, and outboard engines.

Procedure fixture

A Honda SK-50MM, 50 cm³, air-cooled, single-cylinder, two-stroke cycle spark ignition engine is set up on a procedure bed and coupled to a high-speed 10 HP dynamometer. External cooling air is supplied to the engine by a variable delivery fan.

Procedure parameters

A baseline procedure using Jatre 1 reference oil is conducted before any candidates. All candidates for the day are compared against this baseline providing that:

1. The candidates are conducted on the same cylinder and crankshaft assembly as the baseline.
2. The candidates are required to complete procedure within 24 hours of baseline end of procedure.

The procedure is conducted using gasoline mixed with the lubricant to be evaluated at 100:1 fuel oil ratio and is run for 70 minutes at the following conditions. For the CEC, it is 50:1 fuel oil ration, stage 2 is 260:

Stage	1	2
Duration, minutes	10	60, 180*
Engine speed, rpm	6000	6000
Torque, Nm	1.76	WOT
Spark plug gasket, °C	Full Cooling	240, 260*
Exhaust Gas CO, %	Record	6.0, 6.4*

* For CEC L-79-T-97

Procedure parts evaluated

The following parts are rated using JPI-5S-34-91 rating manual and color chips. The initial ratings are then corrected by applying the appropriate weighted detergency correction factor from the following table:

Rated Item	Factor
Top Piston Ring Sticking	2.3
Second Piston Ring Sticking	2.0
Top Land Deposits	1.0
Second Land Deposits	0.6
Top Ring Groove Deposits	1.3
Second Ring Groove Deposits	1.2
Piston Skirt Deposits	0.5
Piston Under Crown Deposits	0.5
Piston Crown Deposits	0.3
Cylinder Head Deposits	0.3

Used lubricant analysis

None.

Pass/fail criteria

The detergency index is calculated using the following formula:

$$\frac{[(\text{Summation of the corrected candidate ratings}) / (\text{Summation of the corrected Jatre 1 ratings})] \times 100}{}$$

A detergency index < 100 indicates performance inferior to the reference oil.

To determine the indices for the classification, many 2T oils from different parts of the world have been tested for their performance. Based on the procedure results, the indices for pass/fail limits for each category have been decided.

The piston skirt deposit index is calculated using the following formula:

$$\frac{[(\text{Piston skirt deposit rating of the candidate}) / (\text{Piston skirt deposit rating of Jatre 1})] \times 100}{}$$

Oils in each category correspond to these 2T oils:

- The “FA” grade corresponds to the oils that have absolute minimum acceptable performance level for two-stroke engines.
- The “FB” & “EGB” grade corresponds to oils which have high performance in lubricity, but are non-low

smoke type.

JASO Detergency (cont’d)

- The “FC” & “EGC” grade corresponds to oils typical of low-smoke type oils in the Japanese market.
- The “EGD” grade corresponds to the oils that have greater detergency performance as identified in proposed Draft International Standard 13738.

The pass/fail limits for each category are as follows:

	Minimum Detergency Index	Minimum Piston Skirt Deposit Index
FA	80*	N/A
FB	85*	N/A
FC	95*	N/A
EGB	85*	85*
EGC	95*	90*
EGD	125**	95**

* In JASO 1-Hour Detergency Procedure

** In CEC 3-Hour Detergency Procedure

JASO Smoke (M342-92)

Specifications

JASO and ISO categories.

Objective

The objective of this procedure is to evaluate the exhaust smoke formation performance of lubricating oils used in two-stroke cycle engines.

Field service simulated

Two-stroke cycle gasoline engines such as motorcycle, utility, and outboard engines.

Procedure fixture

A Suzuki generator SX800 R, 69 cm³, single-cylinder, forced air-cooled, two-stroke cycle spark ignition engine is set up on a procedure bed. An electrical load absorber and a light-absorbing smoke meter are used to perform the smoke procedure.

Procedure parameters

The normal running order for a procedure is reference, candidate, and then reference. A procedure consists of a fuel flush and three procedure runs for each lubricant. The procedure fuel to oil ratio for the reference and candidate is 10:1. A procedure run consists of a burn-off (750 watts, 60 Hz, 320°C (608°F) exhaust gas temperature), cool down to plug gasket temperature of 60°C (140°F), 20-minute idle period at 50 Hz, and a power phase at 50 Hz, 670 watts.

Procedure parts evaluated

None.

Used lubricant analysis

None.

Pass/fail criteria

The exhaust smoke index is calculated using the following formula:

$$[(\text{Avg. Max. Opacity 1st Ref.} + \text{Avg. Max. Opacity 2nd Ref.} / 2 / \text{Avg. Max. Opacity Candidate})] \times 100$$

A smoke index < 100 indicates performance inferior to the reference oil.

To determine the indices for the classification, many two-stroke cycle oils from different parts of the world have been tested for their performance. Based on the procedure results, the indices for pass/fail limits for each category have been decided.

JASO Smoke (cont'd)

Oils in each category correspond to the following two-stroke cycle oils:

- The "FA" grade corresponds to the oils that have the absolute minimum acceptable performance level for two-stroke engines.
- The "FB" & "EGB" grade corresponds to oils which have high performance in lubricity, but are non-low smoke type.
- The "FC" & "EGC" grade corresponds to oils typical of low-smoke type oils in the Japanese market.

The pass/fail limits for each category are as follows:

	Minimum Exhaust Smoke Index
FA	40
FB, EGB	45
FC, EGC, EGD	85

JASO Exhaust System Blocking (M 343-92)

Specifications

JASO.

Objective

The objective of this procedure is to evaluate the degree of engine output decrease due to deposits of carbon on the exhaust systems, etc., in relation to lubricating oil used in two-stroke cycle engines.

Field service simulated

Two-stroke cycle gasoline engines such as motorcycle, utility, and outboard engines.

Procedure fixture

A Suzuki generator SX800 R, 69 cm³, single-cylinder, forced air-cooled, two-stroke cycle spark ignition engine is used. The engine is modified for testing purposes by removing the fuel tank, installing a pressure tap in the reed valve block, and fitting the muffler assembly with exhaust gas temperature and sample taps. During the modification of the muffler, baffles and insulation are removed and discarded.

Procedure parameters

A complete program consists of an "A" and "B" procedure using two engines running simultaneously on the same procedure bed, one engine with the candidate lubricant and the other with the Jatre reference oil. Each engine and exhaust system are thoroughly de-carbonized before starting a procedure. The "B" procedure is conducted by exchanging the lubricants in the engines, i.e. the engine that ran Jatre 1 for the "A" procedure will run the candidate lubricant for the "B" procedure.

The procedure is conducted using premixed gasoline at 5:1 fuel oil ratio. Engines are operated at the following until intake manifold pressure is less than -2.0 kPa.

Parameter	No Load	Load-750 Watts
Engine Speed, rpm	3750	3600
Inlet Pressure, kPa	Record	> -2.0 kPa
Exhaust Gas Temp, °C	330 (625°F)	370(698°F)
Exhaust Gas CO, %	3.5	3.5

Cycle time is maintained to 90 ± 45 seconds. The exhaust gas CO%, engine speed at 750 watts load, and cycle time are established in the first 10 cycles.

Procedure parts evaluated

No procedure parts are evaluated.

JASO Exhaust System Blocking (cont'd)

Used lubricant analysis

None.

Pass/fail criteria

The exhaust system-blocking index is calculated using the following formula:

$$\left[\frac{\text{Total engine operating time of candidate oil}}{\text{Total engine operating time of the reference Jatre 1}} \right] \times 100$$

$$\text{Total operating time} = \text{First procedure operating time} + \text{Second procedure operating time}$$

An exhaust system blocking index < 100 indicates performance inferior to the reference oil.

To determine the indices for the classification, many two-stroke cycle oils from different parts of the world have been tested for their performance. Based on the procedure results, the indices for pass/fail limits for each category have been decided.

Oils in each category correspond to the following two-stroke cycle oils:

- The "FA" grade corresponds to the oils that have the absolute minimum acceptable performance level for two-stroke cycle engines.
- The "FB" & "EGB" grade corresponds to oils which have high performance in lubricity, but are non-low smoke type.
- The "FC" & "EGC" grade corresponds to oils typical of low-smoke type oils in the Japanese market.
- The "EGD" grade corresponds to the oils that have greater detergency performance as identified in proposed Draft International Standard 13738.

The pass/fail limits for each category are as follows:

	Minimum Exhaust System Blocking Index
FB, EGB	45
FC, EGC, EGD	90
FA	30

ASTM Yamaha Y-350M2 Ring Sticking and Deposit Procedure (D 4857)

Specifications

ASTM TC: Sequence I.

Objective

The objective of this procedure is to evaluate the ability of a lubricant to prevent ring sticking and engine deposit formation.

Field service simulated

Field service simulated is typical of large displacement air-cooled engines in off-road use.

Procedure fixture

A Yamaha RD350B twin cylinder, air-cooled, two-stroke cycle, spark-ignition engine is set up on a procedure bed with a modified fuel system and coupled to a 50-HP dynamometer. The separate cylinder arrangement of this engine allows the evaluation of two lubricants, one in each cylinder, at the same time. A variable delivery fan supplies cooling air to the engine.

Procedure parameters

The procedure is conducted for 20 hours on a 25-minute part throttle at 6000 rpm, 5-minute idle cycle with a one-hour soak period after each 150 minutes of running time. Air/fuel ratio and plug temperatures are closely controlled. Fuel/oil ratio is 50:1. Procedure conditions are as follows:

	25-Minute	5-Minute
RPM	6000	2200
Power	8.5	Record
Spark plug gasket temp, °F	375	Record
AFR	12.5	Record

Procedure parts evaluated

Piston assembly and general engine condition are evaluated at the end of the procedure.

Used lubricant analysis

None.

Pass/fail criteria

As good or better than ASTM 600 reference oil within the specified tolerance on average piston varnish and second ring sticking. Candidate may not

scuff the piston.

ASTM Yamaha Lubricity Procedure (D 4863)

Specifications

ASTM TC: Sequence II.

Objective

The objective of this procedure is to evaluate the lubricity of a two-cycle air-cooled engine lubricant.

Field service simulated

Typical of two-stroke cycle air-cooled engines in off road use over hilly terrain.

Procedure fixture

A Yamaha CE50S single cylinder, air-cooled, two-stroke cycle, spark ignition engine is set up on a procedure bed and coupled to a high-speed 10 HP dyna-mometer. External cooling air is supplied to the engine by a variable delivery fan.

Procedure parameters

Each tightening begins with a stabilization period at the following conditions:

Engine, rpm	4000
Load	WOT
Spark plug gasket temp, °F	338(170°C)
Fuel/oil ratio	150:1

After stabilization, the cooling air is stopped and torque decrease is monitored as spark plug gasket temperature rises. Cooling air is restored when spark plug gasket temperature reaches 662°F (350°C). This procedure is repeated five times in each of two sets on both the reference and candidate lubricants.

Procedure parts evaluated

General engine condition is evaluated at the end of the procedure.

Used lubricant analysis

None.

Pass/fail criteria

The candidate must demonstrate performance equal to or better than the ASTM 600 reference oil, using the 95% confidence level.

The torque decrease of the candidate lubricant must be less than or equal to the reference lubricant, using the 95% confidence level.

ASTM Yamaha Pre-Ignition Procedure (D 4858)

Specifications

ASTM TC: Sequence III.

Objective

The objective of this procedure is to evaluate the effect of a lubricant on pre-ignition caused by combustion chamber deposits.

Field service simulated

Field service simulated is typical of two-cycle air-cooled engines operated at full power.

Text fixture

A Yamaha CE50S single-cylinder, air-cooled, two-stroke cycle, spark-ignition engine is set up on a procedure bed and coupled to a high-speed 10 HP dyna-mometer. External cooling air is supplied to the engine by a variable delivery fan.

Procedure parameters

The procedure is run under the following steady-state conditions for 50 hours:

Engine, rpm	4000
Load	WOT
Spark plug gasket temp, °F	392 (200°C)
Fuel/oil ratio	20:1

Procedure parts evaluated

General engine condition is determined.

Used lubricant analysis

None.

Pass/fail criteria

No more than one major pre-ignition is allowed.