THE UNITED KINGDOM VEHICLE APPROVAL AUTHORITY

COMMUNICATION CONCERNING THE TYPE-APPROVAL [(1)]/ ~~EXTENSION~~ [(1)]/ ~~REFUSAL~~ [(1)]/ ~~WITHDRAWAL OF TYPE-APPROVAL~~ [(1)] OF AN ENGINE TYPE OR FAMILY OF ENGINE TYPES WITH REGARD TO THE EMISSION OF POLLUTANTS PURSUANT TO DIRECTIVE 97/68/EC, AS LAST AMENDED BY DIRECTIVE 2012/46/EU

EC type-approval No: e11*97/68SA*2012/46*3267*00

Reason(s) for extension: Not applicable

SECTION I

0. General

0.1. Make (name of undertaking): Yamaha Motor Powered Products Co., Ltd

0.2. Manufacturer's designation of the parent-/and (if applicable) of the family engine(s) type(s) [(1)]:

Parent: MX400 (7HP)
Family: See manufacturer's documentation

0.3. Manufacturer's type coding as marked on the engine(s): See manufacturer's documentation

0.4. Specification of machinery to be propelled by the engine [(2)]: Generator, multi-purpose engine

0.5. Name and address of manufacturer:

Yamaha Motor Powered Products Co., Ltd
200-1 Sakagawa, Kakegawa city
Shizuoka Prefecture, Japan

Name and address of manufacturer's authorized representative (if any): Not applicable

JSR336582

0.6. Location, coding and method of affixing of the engine identification number:
Laminated sticker on fan case

0.7. Location and method of affixing of the EC approval mark: Laminated sticker on fan case

0.8. Address(es) of assembly plant(s):

Yamaha Motor Taizhou O.P.E Co., Ltd
99 Jiangzhou Nanlu Taizhou Jiangsu
China 225300

(1) Delete as appropriate.

(2) As defined in Annex I, section 1 of this Directive (e.g.: 'A')

SECTION II

1. Restriction of use (if any): None

1.1. Particular conditions to be respected in the installation of the engine(s) on the machinery

1.1.1. Maximum allowable intake depression: -3.44 kPa

1.1.2. Maximum allowable back pressure: 7.18 kPa

2. Technical service responsible for carrying out the tests [3]: Vehicle Certification Agency

3. Date of test report: 22 October 2015

4. Number of test report: JSR336582

5. The undersigned hereby certifies the accuracy of the manufacturer's description in the attached information document of the engine(s) described above and that the attached test results are applicable to the type. The sample(s) has (have) been selected by the approval authority and submitted by the manufacturer as the (parent) engine type(s) [1].

Type-approval is GRANTED~~/REFUSED/WITHDRAWN~~ [1]

Place: BRISTOL

Date: 27 OCTOBER 2015

Signature:

D LAWLOR
Head of Technical Standards & Legislation

27-Oct-15
UK Approval Authority

Attachments: Information package.

Test results (see Appendix 1)

Correlation study relevant to sampling systems used which are different from the reference systems [2] (if applicable)

(1) Delete as appropriate.

(2) Specified in Annex I section 4.2.

(3) Fill in n.a. where the tests are carried out by the approval authority itself.

APPENDIX 1 – Not applicable

Test report for compression ignition engines test results[1]

Information concerning the test engine

Engine Type:

Engine identification number:

1. Information concerning the conduct of the test:

1.1. Reference fuel used for test

1.1.1. Cetane number:

1.1.2. Sulphur content:

1.1.3. Density

1.2. Lubricant

1.2.1. Make(s):

1.2.2. Type(s):

(state percentage of oil in mixture if lubricant and fuel are mixed)

1.3. Engine driven equipment (if applicable)

1.3.1. Enumeration and identifying details:

1.3.2. Power absorbed at indicated engine speeds (as specified by the manufacturer):

	Power P_{AE} (kW) absorbed at various engine speeds [1] [2], taking into account Appendix 3 of this Annex		
Equipment	Intermediate speed (if applicable)	Maximum power speed (if different from rated)	Rated speed [3]
Total:			

(1) Delete as appropriate.
(2) Shall not be greater than 10 per cent of the power measured during the test.
(3) Insert values at engine speed corresponding to 100 % normalised speed if NRSC test uses this speed.

1.4. Engine performance

1.4.1. Engine speeds:

Idle: . ……min^{-1}

Intermediate: ……..min^{-1}

Maximum Power…….min^{-1}

Rated [2]: ……min^{-1}

1.4.2. Engine power [1]

	Power setting (kW) at various engine speeds		
Condition	Intermediate speed (if applicable)	Maximum power speed (if different from rated)	Rated speed [1]
Maximum power measured at specified test speed (P_M) (kW) (a)			
Total power absorbed by engine driven equipment as per section 1.3.2 of this Appendix, taking into account Appendix 3 (dW) (b)			
Net engine power as specified in section 2.4 of Annex I (kW) (c)			
c = a + b			

(1) Replace with values at engine speed corresponding to 100 % normalised speed if NRSC test uses this speed.

2. Information concerning the conduct of the NRSC test:

2.1. Dynamometer setting (kW)

	Dynamometer setting (kW) at various engine speeds				
Per cent load	Intermediate speed (if applicable)	63 % (if applicable)	80 % (if applicable)	91 % (if applicable)	Rated speed [1]
10 (if applicable)					
25 (if applicable)					
50					
75 (if applicable)					
100					

(1) Replace with values at engine speed corresponding to 100 % normalised speed if NRSC test uses this speed.

2.2. Emission results of the engine/parent engine (4)

Deterioration Factor (DF): calculated/fixed (4)

Specify the DF values and the emission results in the following table (3):

NRSC test						
DF Mult/add[4]	CO	HC	NO_X	HC + NO_X	PM	
Emissions	CO (g/k/Wh)	HC (g/k/Wh)	NO_x (g/k/Wh)	HC + NO_X (g/k/Wh)	PM (g/k/Wh)	CO_2 (g/k/Wh)
Test result						
Final test result with DF						

Additional control area test points (if applicable)

Emissions at test point	Engine speed	Load (%)	CO (g/k/Wh)	HC (g/k/Wh)	NO_x (g/k/Wh)	PM (g/k/Wh)
Test result 1						
Test result 2						
Test result 3						

2.3. Sampling system used for the NRSC test:

2.3.1. Gaseous emissions (5):

2.3.2. PM (5):

2.3.3.1 Method (4): single/multiple filter

3. Information concerning the conduct of the NRTC test (if applicable):

3.1. Emission results of the engine/parent engine (4)
Deterioration Factor (DF): calculated/fixed (4)

Specify the DF values and the emission results in the following table (4):

Regeneration related data may be reported for Stage IV engines.

NRTC test						
DF Mult/add (4)	CO	HC	NO_X	HC + NO_X	PM	
Emissions	CO (g/k/Wh)	HC (g/k/Wh)	NO_x (g/k/Wh)	HC + NO_X (g/k/Wh)	PM (g/k/Wh)	
Cold start						
Emissions	CO (g/k/Wh)	HC (g/k/Wh)	NO_x (g/k/Wh)	HC + NO_X (g/k/Wh)	PM (g/k/Wh)	CO_2 (g/k/Wh)
Hot start w/o regeneration						
Hot start with regeneration (4)						
kr,u (mult/add) (4) kr,u (mult/add) (4)						
Weighed test result						
Final test result with DF						

Cycle work for hot start w/o regeneration kWh

3.2. Sampling system used of the NRTC test:

Gaseous emissions (5):

PM (5):

Method (4): Single/multiple filter

(1) For the case of several parent engines, the following is be indicated for each of them.

(2) Insert engine speed corresponding to 100 % normalised speed if NRSC test uses this speed.

(3) Uncorrected power measured in accordance with Section 2.4 of Annex I.

(4) Delete as appropriate.

(5) Indicate figure number of system used as defined in Annex VI Section 1 or Section 9 of Annex 4B of ECE R96 03 series of amendments, as applicable.

APPENDIX 2

test results for spark ignition engines

1. INFORMATION CONCERNING THE CONDUCT OF THE TEST(S)[1]:

1.1. Octane number

1.1.1. Octane number: 96.0

1.1.2. State percentage of oil in mixture when lubricant and petrol are mixed as in the case of two stroke engines: Not applicable

1.1.3. Density of petrol for four-stroke engines and petrol/oil mixture for two-stroke engines: 749.4 kg/m^3

1.2. LUBRICANT

1.2.1. Make(s): Yamaha

1.2.2. Type(s): FFO

1.3. ENGINE DRIVEN EQUIPMENT (IF APPLICABLE) – Not applicable

1.3.1. Enumeration and identifying details

1.3.2. Power absorbed at indicated engine speed (as specified by the manufacturer)

Equipment	Power P_{AE} (kW) absorbed at various engine speeds [2], taking into account Appendix 3 of this Annex	
	Intermediate (if applicable)	Rated
Total		

1.4. Engine performance

1.4.1. Engine speeds:

Idle: 2000 min^{-1}

Intermediate: 3060 min^{-1}

Rated: 3600 min^{-1}

1.4.2. Engine power [3]

Condition	Power setting (kW) at various engine speeds	
	Intermediate (if applicable)	Rated
Maximum power measured on test (P_M) (kW) (a)	8.61	-
Total power absorbed by engine driven equipment as per section 1.3.2 of this Appendix, or section 2.8 of Annex III (P_{AE})(kW) (b)	0.00	-
Net engine power as specified in section 2.4 of Annex I (kW) (c)	8.61	-
c = a + b		

1.5. Emission levels

1.5.1. Dynamometer setting (kW)

Percent Load	Dynamometer setting (kW) at various engine speeds	
	Intermediate (if applicable)	Rated
10 (if applicable)	0.86	-
25 (if applicable)	2.16	-
50	4.31	-
75	6.54	-
100	8.61	-

1.5.2. Emission results on the test cycle:

CO: 285.60 g/kWh

HC: 2.99 g/kWh

NO_x: 3.91 g/kWh

(1) In case of several parent engines, to be indicated for each of them.

(2) Must not be greater than 10 % of the power measured during the test.

(3) Uncorrected power measured in accordance with the provisions of section 2.4 of Annex I.

APPENDIX 3

equipment and auxiliaries to be installed for the test to determine engine power

Number	Equipment and auxiliaries	Fitted for emission test
1	Inlet system	
	Inlet manifold	Yes, standard production equipment
	Crankcase emission control system	Yes, standard production equipment
	Control devices for dual induction inlet manifold system	Yes, standard production equipment
	Air flow meter	Yes, standard production equipment
	Air inlet duct work	Yes [(a)]
	Air filter	Yes [(a)]
	Inlet silencer	Yes [(a)]
	Speed-limiting device	Yes [(a)]
2	Induction-heating device of inlet manifold	Yes, standard production equipment. If possible to be set in the most favourable condition
3	Exhaust system	
	Exhaust purifier	Yes, standard production equipment
	Exhaust manifold	Yes, standard production equipment
	Connecting pipes	Yes [(b)]
	Silencer	Yes [(b)]
	Tail pipe	Yes [(b)]
	Exhaust brake	No [(c)]
	Pressure charging device	Yes, standard production equipment
4	Fuel supply pump	Yes, standard production equipment [(d)]
5	Carburation equipment	
	Carburettor	Yes, standard production equipment
	Electronic control system, air flow meter, etc.	Yes, standard production equipment
	Equipment for gas engines Pressure reducer	Yes, standard production equipment
	Evaporator	Yes, standard production equipment
	Mixer	Yes, standard production equipment
6	Fuel injection equipment (petrol and diesel)	
	Prefilter	Yes, standard production or test bed equipment
	Filter	Yes, standard production or test bed equipment
	Pump	Yes, standard production equipment
	High-pressure pipe	Yes, standard production equipment
	Injector	Yes, standard production equipment
	Air inlet valve	Yes, standard production equipment [(e)]
	Electronic control system, air flow meter, etc.	Yes, standard production equipment
	Governor/control system	Yes, standard production equipment
	Automatic full-load stop for the control rack depending on atmospheric conditions	Yes, standard production equipment
7	Liquid-cooling equipment	
	Radiator	No
	Fan	No
	Fan cowl	No
	Water pump	Yes, standard production equipment [(f)]
	Thermostat	Yes, standard production equipment [(g)]
8	Air cooling	

	Cowl Fan or Blower Temperature-regulating device	No [h] No [h] No
9	Electrical equipment Generator Spark distribution system Coil or coils Wiring Spark plugs Electronic control system including knock sensor/spark retard system	 Yes, standard production equipment [i] Yes, standard production equipment Yes, standard production equipment Yes, standard production equipment Yes, standard production equipment Yes, standard production equipment
10	Pressure charging equipment Compressor driven either directly by the engine and/or by the exhaust gases Charge air cooler Coolant pump or fan (engine-driven) Coolant flow control device	 Yes, standard production equipment Yes, standard production or test bed equipment [j] [k] No [h] Yes, standard production equipment
11	Auxiliary test-bed fan	Yes, if necessary
12	Anti-pollution device	Yes, standard production equipment [l]
13	Starting equipment	Test bed equipment
14	Lubricating oil pump	Yes, standard production equipment

(a) The complete inlet system shall be fitted as provided for the intended application: where there is a risk of an appreciable effect on the engine power; in the case of naturally aspirated spark ignition engines; when the manufacturer requests that this should be done. In other cases, an equivalent system may be used and a check should be made to ascertain that the intake pressure does not differ by more than 100 Pa from the upper limit specified by the manufacturer for a clean air filter.

(b) The complete exhaust system shall be fitted as provided for the intended application: where there is a risk of an appreciable effect on the engine power; in the case of naturally aspirated spark ignition engines; when the manufacturer requests that this should be done. In other cases, an equivalent system may be installed provided the pressure measured does not differ by more than 1000 Pa from the upper limit specified by the manufacturer.

(c) If an exhaust brake is incorporated in the engine, the throttle valve shall be fixed in the fully open position.

(d) The fuel feed pressure may be adjusted, if necessary, to reproduce the pressure existing in the particular engine application (particularly when a “fuel return” system is used)

(e) The air intake valve is the control valve for the pneumatic governor of the injection pump. The governor or the fuel injection equipment may contain other devices which may affect the amount of injected fuel.

(f) The cooling-liquid circulation shall be operated by the engine water pump only. Cooling of the liquid may be produced by an external circuit, such that the pressure loss of this circuit and the pressure at the pump inlet remain substantially the same as those of the engine cooling system.

(g) The thermostat may be fixed in the fully open position.

(h) When the cooling fan or blower is fitted for the test, the power absorbed shall be added to the results, except for cooling fans of air cooled engines directly fitted on the crankshaft. The fan or blower power shall be determined at the speeds used for the test either by calculation from standard characteristics or by practical tests

(i) Minimum power of the generator: the electrical power of the generator shall be limited to that necessary for operation of accessories which are indispensable for engine operation. If the connection of a battery is necessary, a fully charged battery in good condition shall be used.

(j) Charge air-cooled engines shall be tested with charge air cooling, whether liquid- or air-cooled, but if the manufacturer prefers, a test bench system may replace the air cooler. In either case, the measurement of power at each speed shall be made with the maximum pressure drop and the minimum temperature drop of the engine air across the charge air cooler on the test bench system as specified by the manufacturer.

(k) These may include, for example, exhaust-gas recirculation (EGR)-system, catalytic converter, thermal reactor, secondary air-supply system and fuel evaporation protecting system.

(l) The power for electrical or other starting systems shall be provided from the test bed.

THE UNITED KINGDOM VEHICLE APPROVAL AUTHORITY

APPROVAL NUMBER: e11*97/68SA*2012/46*3267*00

INFORMATION PACKAGE CONTENTS

INDEX REVISION NUMBER: Not applicable

Total number of sheets: 09 (Nine)

Reasons for Revision: Not applicable

Revision date
&
Office stamp

An executive agency of the Department for Transport
April 2013 Revision 3

27-Oct-15
UK Approval Authority

INFORMATION DOCUMENT

relating to type-approval and referring to measures against the emission of gaseous and particulate pollutants from internal combustion engines to be installed in non-road mobile machinery

(Directive 97/68/EC as last amended by Directive 2012/46/EC)

Parent engine/engine type [1]: MX400 (7HP)

0. General

0.1. Make (name of undertaking) : YAMAHA MOTOR POWERED PRODUCTS CO.,LTD.

0.2. Type and commercial description of the parent- and (if applicable) of the family engine(s) [1] :

Parent; MX400 (7HP) Family; See Appendix 2

0.3. Manufacturer's type coding as marked on the engine(s) [1] :

See paragraph 0.2.

0.4. Specification of machinery to be propelled by the engine [2] : Generator , Multi-purpose Engine

0.5. Name and address of manufacturer :

200-1 Sakagawa Kakegawa City Shizuoka Pref. Japan YAMAHA MOTOR POWERED PRODUCTS CO.,LTD.

Name and address of manufacturer's authorized representative (if any) : NA

0.6. Location, coding and method of affixing of the engine identification number : Fan case (Laminated Sticker)

0.7. Location and method of affixing of the EC approval mark : Fan case (Laminated Sticker)

0.8. Address(es) of assembly plant(s) :

99 Jiangzhou Nanlu Taizhou Jiangsu,China 225300

YAMAHA MOTOR TAIZHOU O.P.E. Co.,Ltd.

Attachments

1.1. Essential characteristics of the parent engine(s) (see Appendix 1)

1.2. Essential characteristics of the engine family (see Appendix 2)

1.3. Essential characteristics of engine types within the family

2. Characteristics of engine-related parts of the mobile machinery (if applicable)

3. Photographs of the parent engine

4. List further attachments if any

---

(1) Delete as appropriate

(2) As defined in Annex 1, section 1 (e.g. 'A')

Appendix 1

ESSENTIAL CHARACTERISTICS OF THE (PARENT) ENGINE [1]

1. DESCRIPTION OF ENGINE

1.1. Manufacturer : YAMAHA MOTOR POWERED PRODUCTS CO.,LTD.

1.2. Manufacturer's engine code : MX400 (7HP)

1.3. Cycle : four stroke/two stroke[2]

1.4. Bore : 85 mm

1.5. Stroke : 71 mm

1.6. Number and layout of cylinders : 1 cylinder 64° incline

1.7. Engine capacity : 402 cm^3

1.8. Rated speed : 3,600 r.p.m.

1.9. Maximum torque speed : 2,400 r.p.m.

1.10. Volumetric compression ratio [3] : 8.2

1.11. Combustion system description : 4 stroke

1.12. Drawing(s) of combustion chamber and piston crown : See Attached Sheet A-1,A-2

1.13. Minimum cross sectional area of inlet and outlet ports : See Attached Sheet B

1.14. Cooling system

1.14.1. *Liquid*

1.14.1.1. Nature of liquid : NA

1.14.1.2. Circulating pump(s) : NA

1.14.1.3. Characteristics or make(s) and type(s) (if applicable) : NA

1.14.1.4. Drive ratio(s) (if applicable) : NA

1.14.2. *Air*

1.14.2.1 Blower :

1.14.2.2 Characteristics or make(s) and type(s) (if applicable) : Centrifugal Fan

1.14.2.3 Drive ratio(s) (if applicable) : 1:1 (Direct)

1.15. Temperature permitted by the manufacturer

1.15.1. Liquid cooling : maximum temperature at outlet : NA K

1.15.2. Air cooling : reference point : Spark Plug

Maximum temperature at reference point : 503 K

1.15.3. Maximum charge air outlet temperature of the inlet intercooler (if applicable) NA K

1.15.4. Maximum exhaust temperature at the point in the exhaust pipe(s) adjacent to the outer flange(s) of the exhaust manifold(s) : Exhaust Gas Temperature 1053 K

1.15.5. Lubricant temperature : minimum NA K

maximum 393 K

1.16. Pressure charger : No

1.16.1. Make : NA

1.16.2. Type : NA

1.16.3. Description of the system (e.g. max charge pressure, waste-gate, if applicable) : NA

1.16.4. Intercooler : N.A.

1.17. Intake system : Maximum allowable intake depression at rated engine speed and at 100% load : -3.44 kPa

1.18. Exhaust system : Maximum allowable exhaust back pressure at rated engine speed and at 100% load : 7.18 kPa

2. ADDITIONAL ANTI-POLLUTION DEVICES (if any, and of not covered by another heading)

- Description and/or diagram(s) : NA

3. FUEL FEED FOR DIESEL ENGINES

3.1. Feed pump

Pressure[2] or characteristic diagram : NA kPa

3.2. Injection system

3.2.1. *Pump*

3.2.1.1. Make(s) : NA

3.2.1.2. Type(s) : NA

3.2.1.3. Delivery :

Mention the method used : NA

3.2.1.4. Injection advance NA

3.2.1.4.1. Injection advance curve[2] : NA

3.2.1.4.2. Timing[2] : NA

3.2.2. *Injection piping*

3.2.2.1. Length : NA mm

3.2.2.2. Internal diameter : NA mm

3.2.3. *Injector(s)*

3.2.3.1. Make(s) : NA

3.2.3.2. Type(s) : NA

3.2.3.3. Opening pressure[2] or characteristic diagram : NA kPa

3.2.4 *Governor*

3.2.4.1. Make(s) : NA

3.2.4.2. Type(s) : NA

3.2.4.3. Speed at which cut-off starts under full load[1] : NA rpm

3.2.4.4. Maximum no-load speed [1] : NA rpm

3.2.4.5. Idling speed[1] : NA rpm

3.3. Cold start system

3.3.1 Make(s) : NA

3.3.2 Type(s) : NA

3.3.3 Description :

4. FUEL FEED FOR PETROL ENGINES

4.1. Carburettor :

4.1.1. Make(s) : RUIXING CARBURETOR MANUFACTURING CO.,LTD.ZHEJIANG

4.1.2. Type(s) : 7HC20

4.2. Port fuel injection : single-point or multi-point : NA

4.2.1. Make(s) : NA

4.2.2. Type(s) : NA

4.3. Direct injection : NA

4.3.1. Make(s) : NA

4.3.2. Type(s) : NA

4.4. Fuel flow [g/h] and air/fuel ratio at rated speed and wide open throttle :

5. VALVE TIMING

5.1. Maximum lift and angles of opening and closing in relation to dead centers or equivalent data :

	Max. Lift	Event Angle	Opening Angel	Closeing Angle
INTAKE	7.4 mm	ATDC 108°	BTDC 20°	ATDC 236°
EXHAUST	7.4 mm	ATDC 108°	BTDC 236°	ATDC 20°

5.2. Reference and/or setting ranges[(2)] : Ramp Height 0.45mm

5.3. Variable valve timing system (if applicable and where intake and/or exhaust) : NA

5.3.1. Type: continuous or on/off : NA

5.3.2. Cam phase shift angle : NA

6. PORTING CONFIGURATION

6.1. Position, size and number : See Attached Sheet B

7. IGNITION SYSTEM

7.1. Ignition coil

7.1.1. Make(s) : LANGFANG KOKUSAN ELECTRIC CO.,LTD.

7.1.2. Type(s) : T.C.I.

7.1.3. Number : 7CT-01

7.2. Spark plug(s) :

7.2.1. Make(s) : NGK

7.2.2. Type(s) : BPR-4ES

7.3. Magneto :

7.3.1. Make(s) : LANGFANG KOKUSAN ELECTRIC CO.,LTD.

7.3.2. Type(s) : Fly Wheel Magneto

7.4. Ignition timing :

7.4.1. Static advance with respect to top dead centre [crank angle degrees] : BTDC 15°

7.4.2. Advance curve, if applicable : NA

Appendix 2

ESSENTIAL CHARACTERISTICS OF THE ENGINE FAMILY

1. COMMON PARAMETERS[1] :

1.1. Combustion cycle : 4 Stroke

1.2. Cooling medium : Air

1.3. Method of air aspiration : Natural Aspiration

1.4. Combustion chamber type/design : See Attached Sheet A-1

1.5. Valve and porting - configuration, size and number : See Attached Sheet B

1.6. Fuel system : Gravity (No Pump)

1.7. Engine management systems :

Proof of identity pursuant to drawing number(s) :

- charge cooling system : NA

- exhaust gas recirculation[2] : NA

- water injection/emulsion[2] : NA

- air injection[2] : NA

1.8. Exhaust after-treatment system[2] : NA

proof of identical (or lowest for the parent engine) ratio : system capacity/fuel delivery per stroke,

pursuant to diagram number(s) :

2.ENGINE FAMILY LISTING

2.1. Name of engine family : MX400(7HP)

2.2. Specification of engines within this family : See Chart 2.1

(1) To be completed in conjunction with the specifications given in sections 6 and 7 of Annex 1.

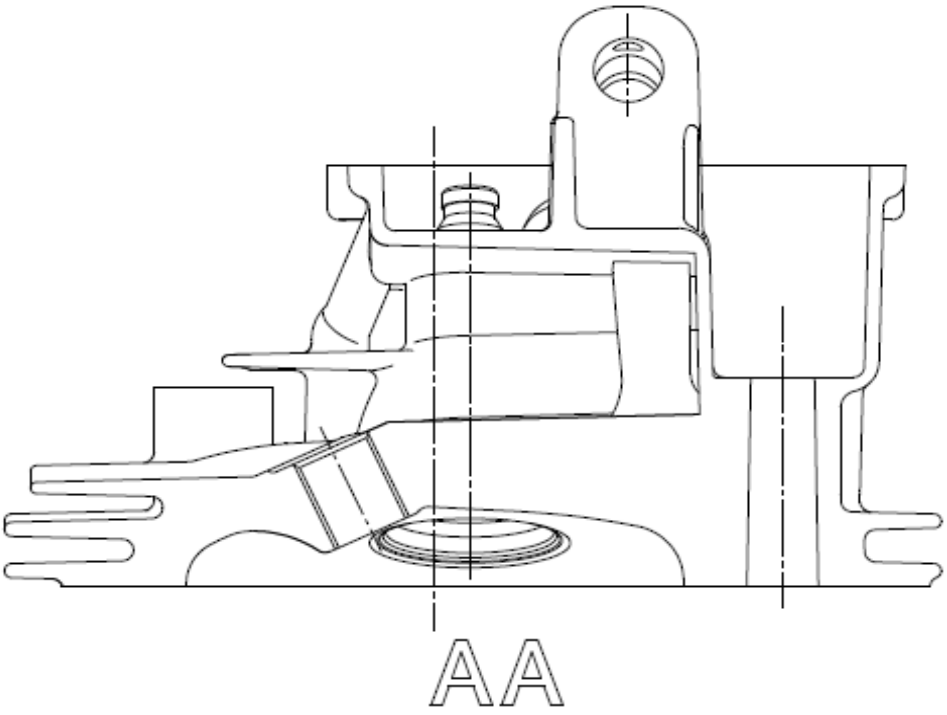
(2) If not applicable mark n.a.

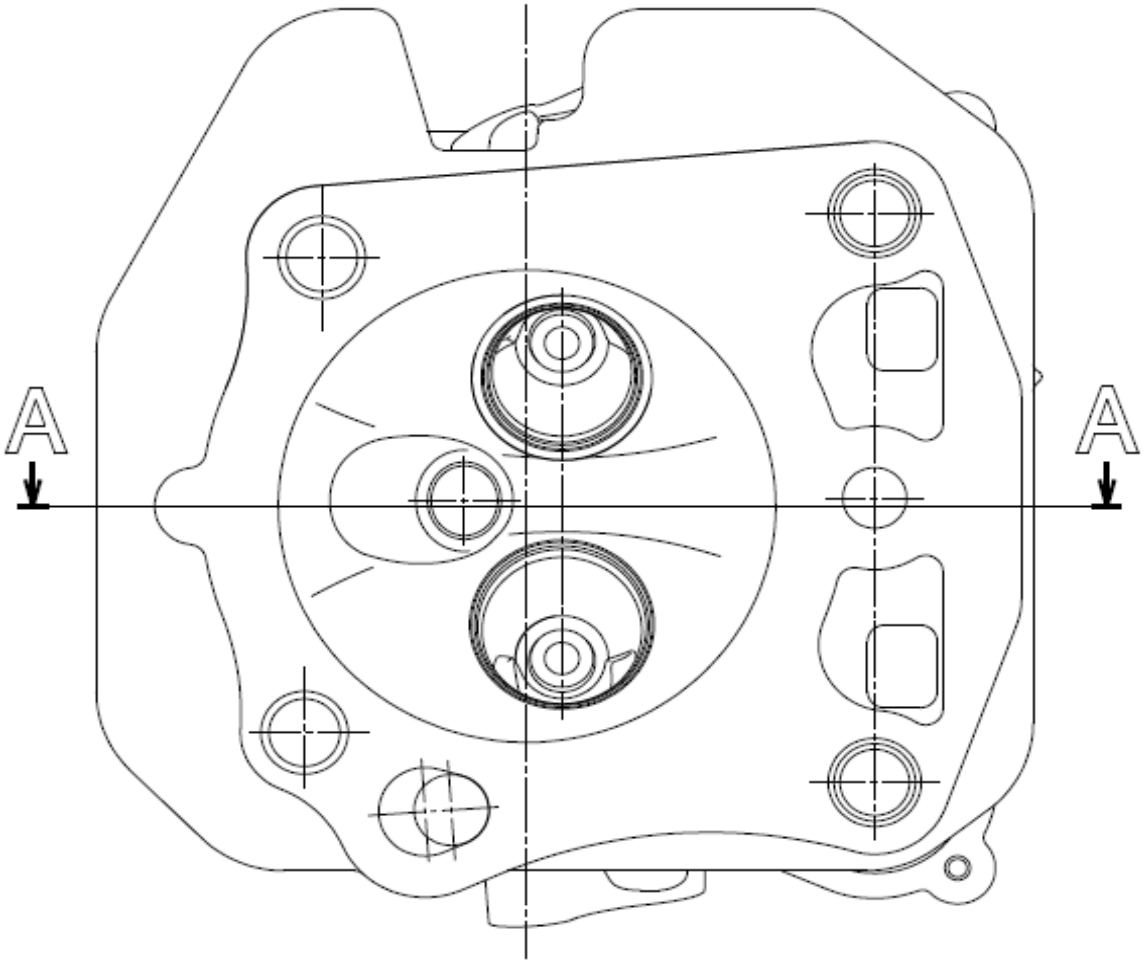
Chart 2.1 Specification of engines within this family

						Parent engine[1]
Engine type						MX400(7HP)
No of cylinders						1
Rated speed (rpm)						3,600
Fuel delivery per stroke (mm^3) for diesel engines, fuel flow (g/h) for petrol engines						3203g/h
Rated net power (kW)						7.8
Maximum torque speed (rpm)						2,400
Fuel delivery per stroke (mm^3) for diesel engines, fuel flow (g/h) for petrol engines						2265g/h
Maximum torque (Nm)						28.7
Low idle speed (rpm)						2,000
Cylinder displacement (in % of parent engine)						100

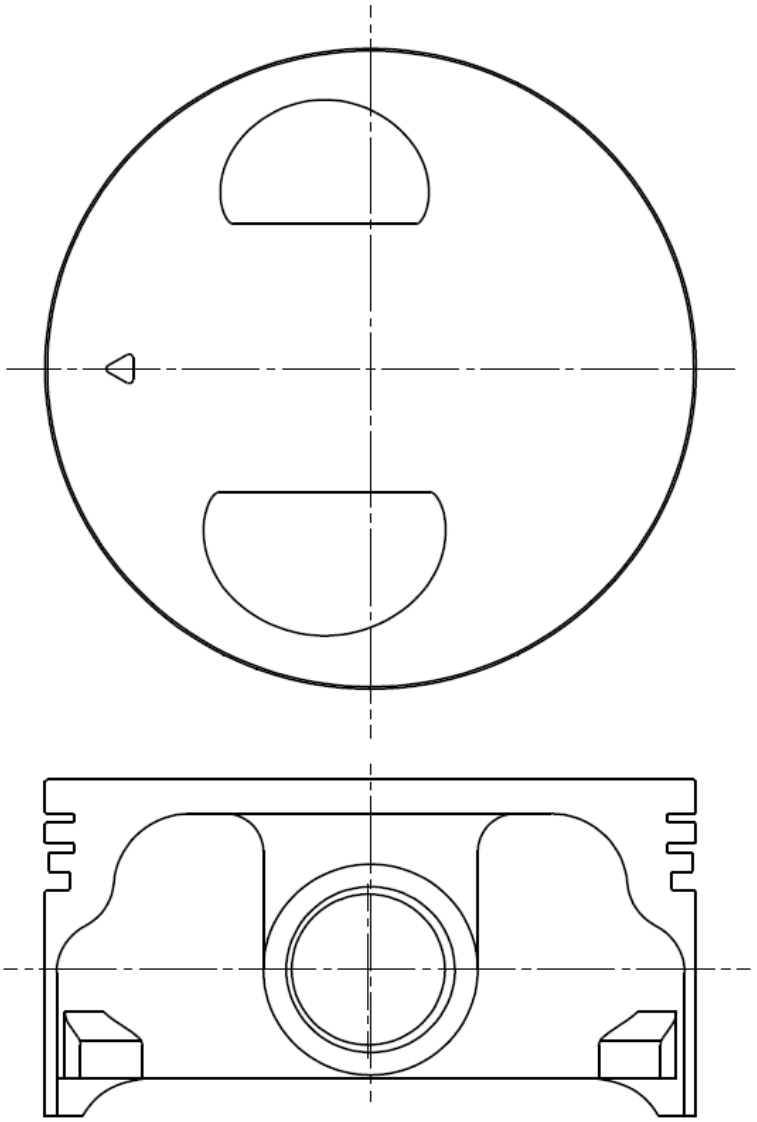
[1] For full details see Appendix 1.

A-1 : Drawing of combustion chamber (scale 1:1)

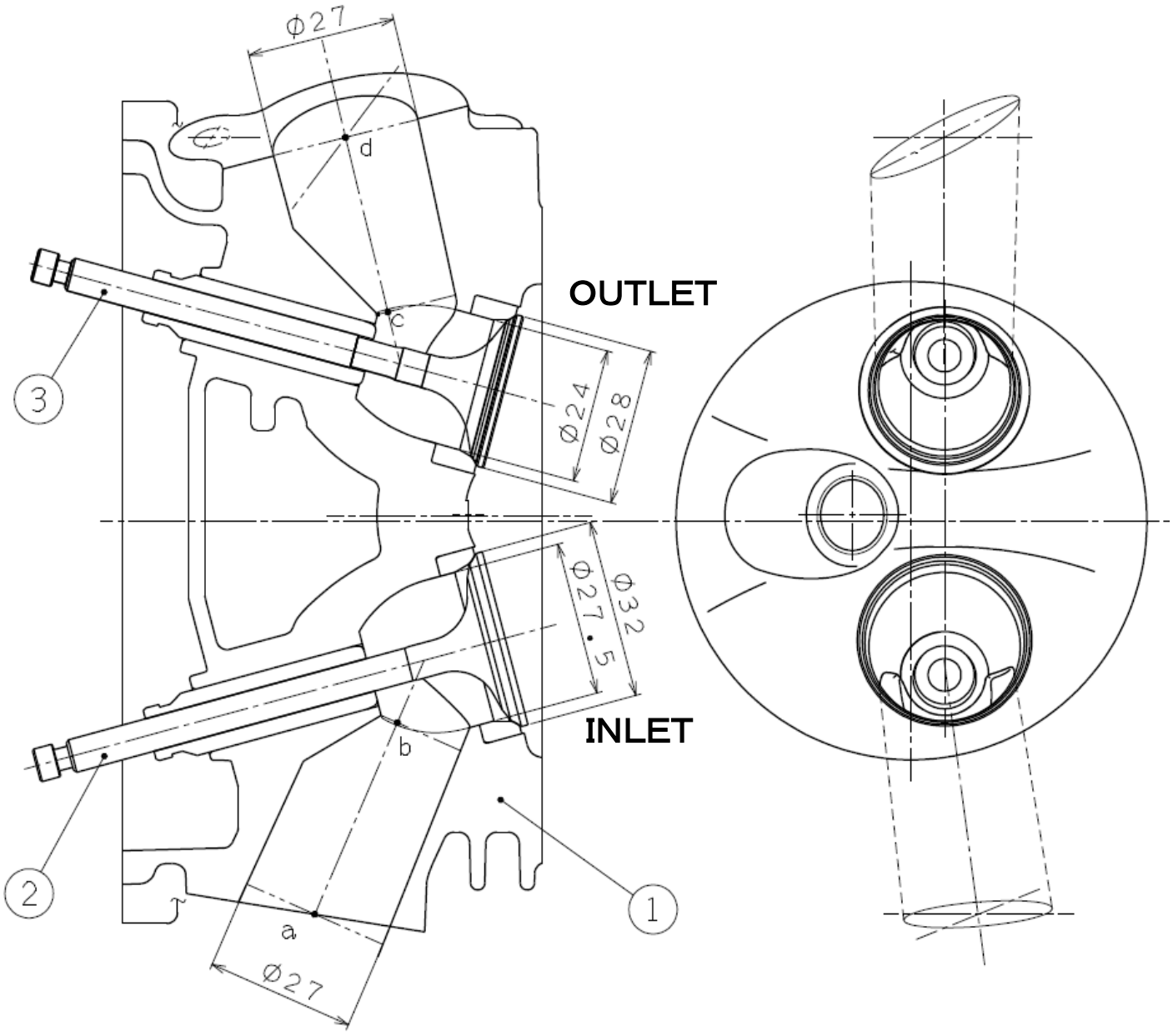




A-2 : Drawing of piston crown (scale 1:1)



B : Drawing of inlet and outlet ports (scale 1:1 , unit : mm)



①	HEAD, CYLINDER
②	VALVE, INTAKE
③	VALVE, EXHAUST

Table 1 Cross sectional area of each points

point	area	remarks
a	573 mm^2	
b	393 mm^2	Inlet Min.
c	361 mm^2	Outlet Min.
d	573 mm^2	

VCA, 1 Eastgate Office Centre,
Eastgate Road, Bristol, BS5 6XX, United Kingdom
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Report Number: JSR336582 Issue: 0

Test Report:
NRMM Emissions (SI Engines – Stage II)

Legislation

Directive 97/68 consolidated to 2012/46/EU

Test Details

Location of Test:	Test Room 7, Yamaha, Shizuoka Pref. Japan
Date of Test:	03 September 2015, 14 October 2015
VCA Representative(s):	Brent Waddington, Eiji Semoto, Mika Burlison
Manufacturer's Representative(s):	Ohta san and Sugiyama san
Reason for Test Report:	New approval / ~~Extension of approval / Test report only~~

Manufacturer Details

Name and Address:	Yamaha Motor Powered Products Co.,Ltd 200-1 Sakagawa Kakegawa City, Shizuoka Pref. Japan
Type:	MX400(7HP)
Commercial Description:	Generator/multi-purpose engine
Category:	SN:4 – displacement ≥ 225cc

Conclusion

The above mentioned engine was tested in accordance with the above mentioned legislation and was found to comply in all respects.

Signature:

Name:	Mika Burlison
Position:	Type Approval Engineer
Date:	22 October 2015

List of Annexes

Annex	No of Pages	Subject
I		

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Worst Case Rationale

Single engine MX400(7HP) 400cc. Emissions test using the G1 test cycle at an intermediate speed of 3060rpm. Engine run to EDP (500 hours) and calculated DF values used for final emissions results. Carburettor has only one setting.

Governor incorporated in carburettor in the form of a spring and weight. Manufacturer specifies maximum full load speed (rated speed) allowed by the governor as 3600rpm. Rated net power at this engine speed measured as 7.8kW, same as declared in manufacturer's documents. Maximum power measured at intermediate speed of 3060rpm is 8.6kW so this is the full load value used to determine the dynamometer settings for the emissions test. Governor removed for emissions test as difficult to keep engine operation stable during the test and it only affects engine power at speeds above the intermediate test speed.

Tests Required

	Yes, NA, See Report … / Approval … / Annex …
Administrative Provisions:	Yes
Emissions Durability Period:	Yes
Test Conditions:	Yes
Emissions Test:	Yes

Engine Specification

Engine Serial Number:	None – prototype engine
Declared Air Inlet Restriction:	-3.44kPa
Declared Exhaust Back Pressure:	7.18kPa

Manufacturer's Documentation

Manufacturer's documentation is complete and reflects the agreed specification for the engine tested and covers all variants and versions agreed in the worst case rationale. Yes

Facility and Equipment Checks

Calibration certificates checked and valid, recorded in the following table: Yes

Equipment	Serial / Certificate No.	Calibration date
Fuel flow meter	07100728	24 April 2015 (12 months)
Analyser Linearity Checks	S2000820289000010	17 July 2015 (6 months)
Meiden Dynamometer	2A98451R1	30 June 2015 (12 months)
Manometer (back pressure)	T551788	30 June 2015 (12 months)
Barometer	Z915007	7 April 2015 (12 months)
NOx Converter	95.5%	27 August 2015
NOx Converter (EDP)	95.2%	6 October 2015

**Specify calibrated date + (interval) or calibration due date.*

Test Requirements		Complies Yes / NA

Administrative Provisions

Engine Category

Article 9a, 1. Appropriate category selected for engine with net power < 19kW. — Yes

Hand-held:

- ~~SH:1 – Displacement: < 20 cc*~~
- ~~SH:2 – Displacement: ≥ 20 cc, < 50 cc*~~
- ~~SH:3 – Displacement: ≥ 50 cc*~~

Non-hand-held:

- ~~SN:1 – Displacement: < 66 cc*~~
- ~~SN:2 – Displacement: ≥ 66 cc, < 100 cc*~~
- ~~SN:3 – Displacement: ≥ 100 cc, < 225 cc*~~
- SN:4 – Displacement: ≥ 225 cc*

**Strike-through, as appropriate.*

Engine Markings

Ann I, 3.2. The engine markings must include the trade mark or trade name of the manufacturer of the engine, the EC type-approval number and the parenthesised number of the emissions stage in roman numerals. — Yes

Ann I, 3.2.4. Parenthesised letters SV for small volume engine manufacturer used under the small volume derogation. — NA

Ann I, 3.3. Marks durable for the useful life of the engine and must be clearly legible and indelible. — Yes

Ann I, 3.4. Marks secured to an engine part necessary for normal engine operation and not normally requiring replacement during engine life. — Yes

Emissions Durability Period

Ann IV, App 4, 2.1. EDP category selected which most closest approximates the expected useful life. — Yes

~~Hand-held (SH:1/SH:2/SH:3):~~

- ~~Category 1 – 50 hrs*~~
- ~~Category 2 – 125 hrs*~~
- ~~Category 3 – 300 hrs*~~

~~Non-hand-held (SN:1):~~

- ~~Category 1 – 50 hrs*~~
- ~~Category 2 – 125 hrs*~~
- ~~Category 3 – 300 hrs*~~

~~Non-hand-held (SN:2/SN:3):~~

- ~~Category 1 – 125 hrs*~~
- ~~Category 2 – 250 hrs*~~
- ~~Category 3 – 500 hrs*~~

Non-hand-held (SN:4):

- ~~Category 1 – 250 hrs*~~

- Category 2 – 500 hrs*
- ~~Category 3 – 1000 hrs*~~

**Strike-through, as appropriate.*

Ann IV, App 4, 1.4.	Manufacturer calculates a DF for each regulated pollutant, according to requirements.	Yes
VCA	Engine run to EDP and used for final emissions results. Both sets of results annexed to test report.	Yes

Test Conditions

Ann IV, 1.2.	Engine mounted on test bench and connected to a dynamometer.	Yes
Ann IV, 2.1.1.	Atmospheric parameter is 0.93 ≤ fa ≤ 1.07 before and during test.	Yes
Ann IV, 2.2.	Air inlet restriction within ± 10% of the value specified by the manufacturer at rated speed and full load with a new air cleaner. Declared: -3.44 kPa Measured: -3.44 kPa	Yes
Ann IV, 2.3.	Exhaust back pressure within ± 10% of the value specified by the manufacturer at rated speed and full load. Declared: 7.18 kPa Measured: 7.18 kPa	Yes
Ann IV, 2.4.	The engine cooling system has sufficient capacity to maintain the engine at normal operating temperatures, prescribed by the manufacturer used.	Yes
Ann IV, 2.5.	Lubricating oil as specified by the manufacturer and representative of oil available on the market. Make: Yamaha Type: FFO SAE viscosity: 10W-40	Yes
Ann IV, 2.6.	Engines with limited adjustable carburettors tested at both extremes of the adjustment: **Only one setting, non-adjustable**	N/A
Ann IV, 2.7.	Test fuel complies with reference fuel requirements from Annex V. Specification: Euro 2 Octane number: 96.0 Density: 749.4kg/m^3 Petrol/Oil mix: Not applicable	Yes
Ann IV, 2.7.	For two-stroke engines, the correct manufacturer's declared fuel/oil ratio must be used.	N/A
Ann IV, 2.8.	Auxiliaries necessary only for the operation of the machine and which may be mounted on the engine shall be removed for the test.	Yes

Ann IV, 2.8.	Where auxiliaries have not been removed, the power absorbed (P_{AE}) by them shall be determined in order to calculate the dynamometer settings.	N/A

Emissions Test

Test Equipment

Ann VI, 1.	Indicate sampling system number used for test: Test Cell 7	
Ann IV, App 2, 1.11.	Analyser calibration within 3 months. Make and type: Meidensha Model: 11kW DC-DY Serial number: 2A98451R1	Yes
Ann IV, App 1, 1.3.	The calibration of all measuring instruments complies with the requirements given in tables 2 and 3.	Yes
Ann IV, App 2, 1.1.	Gas analyser calibration performed as often as necessary to fulfil accuracy requirements.	Yes
Ann IV, App 2, 1.5.5.1.	Gas analyser calibration gas concentration not less than 90% of the full scale value.	Yes
Ann IV, App 2, 1.5.5.1.	Gas analyser calibration curve points must not differ from the least-squares best-fit line by more than ± 2% of reading or ± 0.3% of full scale, whichever is larger.	Yes
Ann IV, App 2, 1.8.10.	NOx converter efficiency not less than 90%.	Yes
Ann IV, App 1, 1.4.3.4.	Heated HC sample line maintained between 180 - 200°C.	Yes
Ann IV, App 1, 1.4.3.5.	Heated NO_x sample line maintained between 55 - 200°C.	Yes

Pre-test

Ann IV, 3.5.1.	Appropriate test cycle selected. ~~- D: Engines with constant speed and intermittent load, such as generating sets*~~ - G1: Non-hand-held intermediate speed applications* ~~- G2: Non-hand-held rated speed applications*~~ ~~- G3: Hand-held applications*~~ **Strike-through, as appropriate.*	Yes
Ann IV, 3.5.1.	Dynamometer settings verified for the following test speeds: Idle speed: 2000 rpm Intermediate speed: 3060 rpm Rated speed: 3600 rpm	Yes
Ann IV, App 2, 1.4.	Sample line leakage test performed prior to test.	Yes

Ann IV, 3.4.	Emissions analysers zeroed and spanned.	Yes
Ann IV, 3.5.2.	Warming up of the engine and the system shall be at maximum speed and torque in order to stabilise the engine parameters, according to the recommendations of the manufacturer.	Yes
Ann IV, 3.5.3.	Each mode sampling time shall be at least 180 s. The exhaust emission concentration values shall be measured and recorded for the last 120 s of the respective sampling time.	Yes
	Dilute Measurement – Not applicable	
Ann IV, 3.2.	Dilution system has warmed and all temperatures and pressures have been stabilised at full load and rated speed, if applicable.	N/A
Ann IV, 3.3.	Total dilution ratio is not less than four.	N/A
Ann IV, 3.3.	Background conditions determined with a bag system and continuously sampled throughout the test sequence.	N/A
Ann IV, 3.3.	Background conditions determined with a non-bag system with samples taken at beginning, mid-point and end, then averaged.	N/A
Ann IV, 3.3.	Background measurements are omitted from the calculations, as requested by the manufacturer.	N/A
	Post-test	
Ann IV, 3.5.3.	For speed controlled dynamometers, specified speed within greater of ± 1% or ± 3 min^{-1} and torque within ± 2% of maximum torque, except for low idle.	Yes
Ann IV, 3.5.3.	For load controlled dynamometers, specified speed within greater of ± 2% or ± 3 min^{-1} and torque within ± 5% of maximum torque, except for low idle.	N/A
Ann IV, 3.5.3.	For load controlled dynamometers, at modes with a setting of > 50% maximum torque specified torque within tolerance ± 5%, except for low idle.	N/A
Ann IV, 3.5.3.(b)	For load controlled dynamometers, at modes with a setting of < 50% maximum torque specified torque within greater of ± 10% or ± 0.5 Nm.	N/A
Ann IV, 3.5.4.	Emissions data for minimum of the last 180 secs of mode.	Yes
Ann IV, 3.4.	Zero and span pre/post difference < 2%.	Yes

Test Results

Delete/Repeat as necessary

Dynamometer Settings

% load	Intermediate-3060rpm		Rated	
	kW	Nm	kW	Nm
10	0.86	2.67	-	-
25	2.16	6.76	-	-
50	4.31	13.46	-	-
75	6.54	20.42	-	-
100	8.61	26.90	-	-

Emissions Results

Test ID: 2015/09/03, 2015/10/14

	CO	HC	NO_x	HC + NO_x
DF - mult	1.000	-	1.080	1.049
Emissions	CO (g/kWh)	HC (g/kWh)	NO_x (g/kWh	HC + NO_x (g/kWh)
Test result	285.60	-	3.62	6.58
Final test result with DF	285.60	-	3.91	6.90
Limits				
SN:1	610	-	10	50.0
SN:2	610	-	10	40.0
SN:3	610	-	10	16.1
SN:4	**610**	**-**	**10**	**12.1**
SH:1	805	-	10	50
SH:2	805	-	10	50
SH:3	603	-	10	72

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Remarks

None

Note: VCA apply measurement uncertainty to calibrated items but not test results.