Test report

Gasoline generator SE2000i/SE2000iE

Anton Fedorov

Dalarna University
Högskolan Dalarna

Dalarna University
791 88 Falun
Sweden
Tel (+46)023-77 80 00
www.du.se

Table of Contents

Introduction

The test has been done on request of Solorder AB. The purpose of the test is to verify the compliance of generators key performance parameters with the manufacturer specification. The following parameters to be verified:

- How well the product starts up at different temperature conditions.
- Fuel consumption.
- Nominal and maximum power of AC outlets, overload protection.
- General performance with different AC loads.
- THD (Total Harmonic Distortion), sinewave shape, voltage and frequency.
- Functionality of supplementary DC/USB outlets.
- Noise level.
- App functionality
- 50 hours reliability test with nominal load.

The company has provided two new test units: SE2000i and SE2000iE. The units are identical with an exception of availability of electrical start function and integrated start-up battery on the SE2000iE. Product manufacturer specification is available in Appendix.

Method

The testing has been carried out in Dalarna University outdoor lab. The units has been tested outdoors with the abmient temperature varying between -12 and +10 °C. Testing was performed between 2023-01-18 abd 2023-02-28.

The following tools have been used for measurements:
- Fluke 345 for measuring of THD, sinewave shape, voltage and frequency.
- Biltema 46-3267 for measuring AC output power, AC current and power factor.
- Keysight 3054A oscilloscope for measuring frequency and sinewave shape.
- Extech EX520 for measuring DC voltage and current.
- UNI-T UT353 DB meter for noise level.

The following equipment have been used as loads:
- Terco TB40 3kW power rheostat as resistive load.
- 550W industrial halogen light as resistive load.
- 1,5 kW air compressor driven by an induction motor as inductive load.

Further in this report **Unit 1 will be referred to the SE2000i** (without electric starting function) and **Unit 2 referred to SE2000iE** (with electric starting function).

Procedure:

Firstly both new units have been prepared and filled in with oil and fuel according to the manul. Then both units have been started and run for about 30 minutes without any load. Then both units have been tested with a 550W AC load for about 4-5 hours within which the main performance indicators have been tested and measured. Cold and warm engine start tests have been then done. After, the Unit 2 have been cycle tested for 53 hours with the nominal resistive load ot 1,8 kW with periodic checks and measurements. The test was finilized by the final measurement test of main performance indicators.

Limitations

Due to temperature conditions it was not possible to test the generators with the ambient temperature above +10 °C. Therefore, the capabilities of generator's cooling unred warm ant hot abmient temperatures was not possible to test.

Cycle test was limited to the continious operation of the generator under constant nominal resistive load ot 1,8 kW after which all the electrical measurement were repeated. No disassembly and physical measurements/wear evaluation of engine components has been done under this test.

Results.

1. Starting test

In order to test how well the generator starts in cold temperatures, it has intentionally been placed outdoors under -10 °C at least 2 hours before starting. Starting has been performed with both, manual and electric starter with the engagement of choke. Warm starts have been done multiple times during testing.

Each time both units started well, **no starting problem has been detected**. Directly after running out of fuel and refilling, units usually started at the second trial. When fuel had been present in the tank for some time, usually units started from the first trial.

2. Fuel consumption

Fuel consumption has been measured by filling the tank of the generator with a specific amount of fuel and then running it with a constant load until a full stop. The consumption then was calculated by dividing the fuel volume by operated time. Fuel consumption was tested with 2 types of loads: a 550 W and 1800 W. The results are the following:

	Consumption, l/h	
	Unit 1	Unit 2
550 W	0,525	0,55
1800 W		1,025

The result of the testing verifies the fuel consumption is withing the manufacturer specified values or lower.

3. Nominal and maximum power of AC outlets, overload protection

Each unit has been tested with a nominal resistive load of 1800 W (cos $\varphi = 1$) as well as maximum resistive load of 2100 W. **Both units showed stable long term performance with the nominal load**. When exceeding the load in a range of 1900 W to 2100 W, the units could still generate the stabe output power for a period of time of about 30 seconds, after which either overload protection was triggered or the RPM became unstable until the load was decrease back to nominal.

Each attempt to connect a resistive load that exceeds the maximum load significantly, has trigurred the overload protection within a few seconds. **Thus, AC overload protection functions.**

4. General performance with different AC loads

In order to understand how the generator performs not only with a resistive constant load, but also with a variable inductive loads, it was also tested with an air compressor rated 1500 W with a cos $\varphi \approx 0.8$. The compressor is driven by an asynchronous motor and draws high current during ramping, expecially when the compressor vessel is pressurised. This load corresponds to about 1875 W apparent power the generator needs to produce.
The generator managed to start and run the compressor, even when the last has been pressurised. The start was slower that compared to connecte to the grid; the generator took about 1 second to detect and to adopr the RMP to the load.

5. THD (Total Harmonic Distortion), sinewave shape, voltage and frequency.

Manufacturer specifies the unit to be equipped with an inverter and THD to be within 3%.

THD level has meen continiously monitored during the cycle test. The following table represents the **highest detected THD** level with the corresponding constant load:
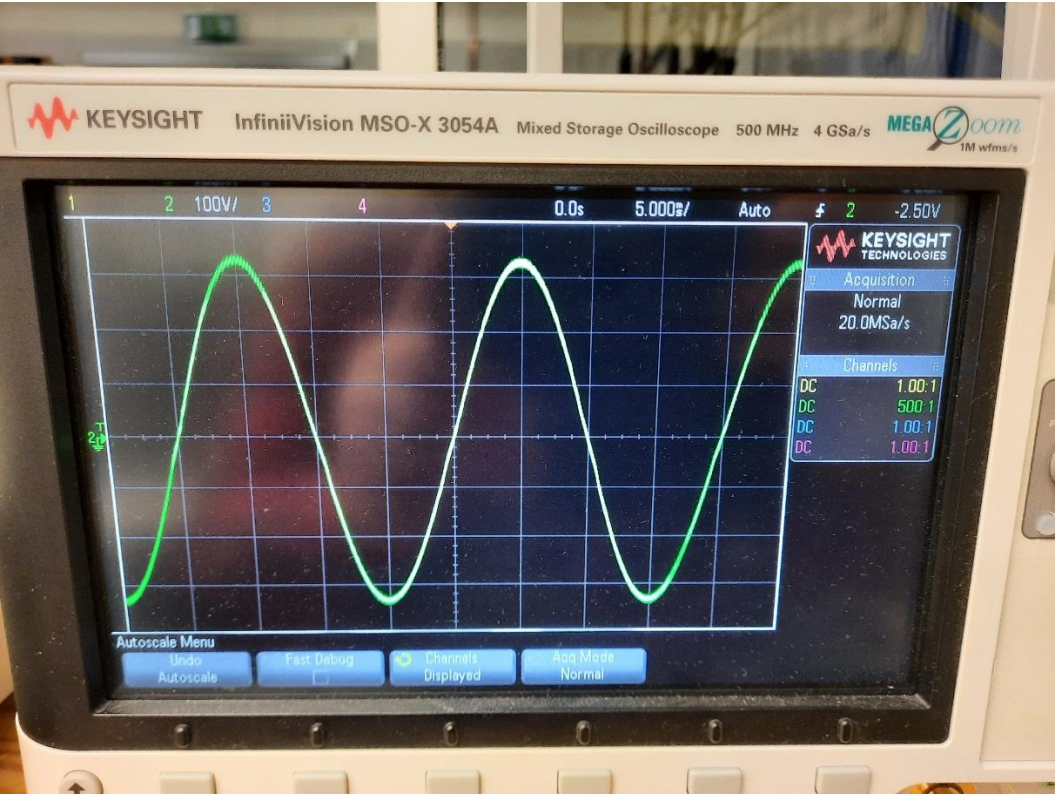
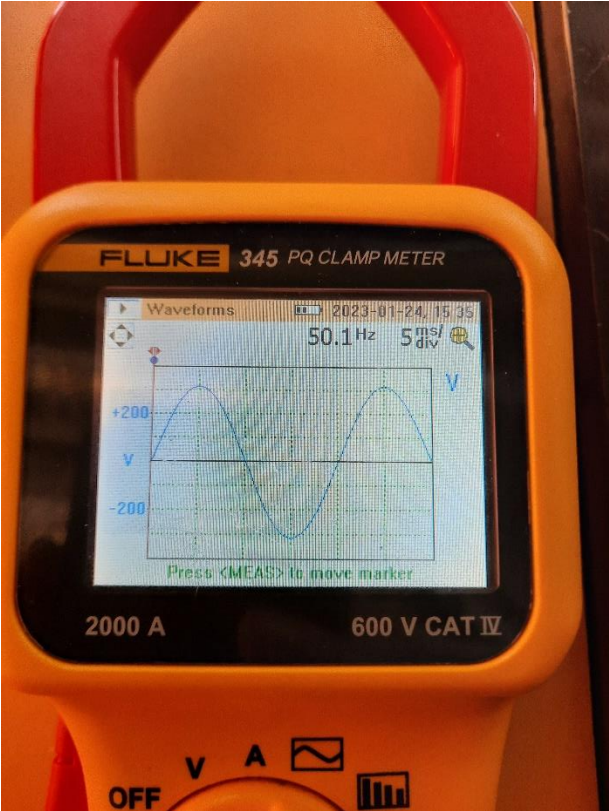| Load, W	THD, %
0	0,1
550	0,1
1800	0,8

Pictures below represent the measured THD, sine wave shape and FFT:
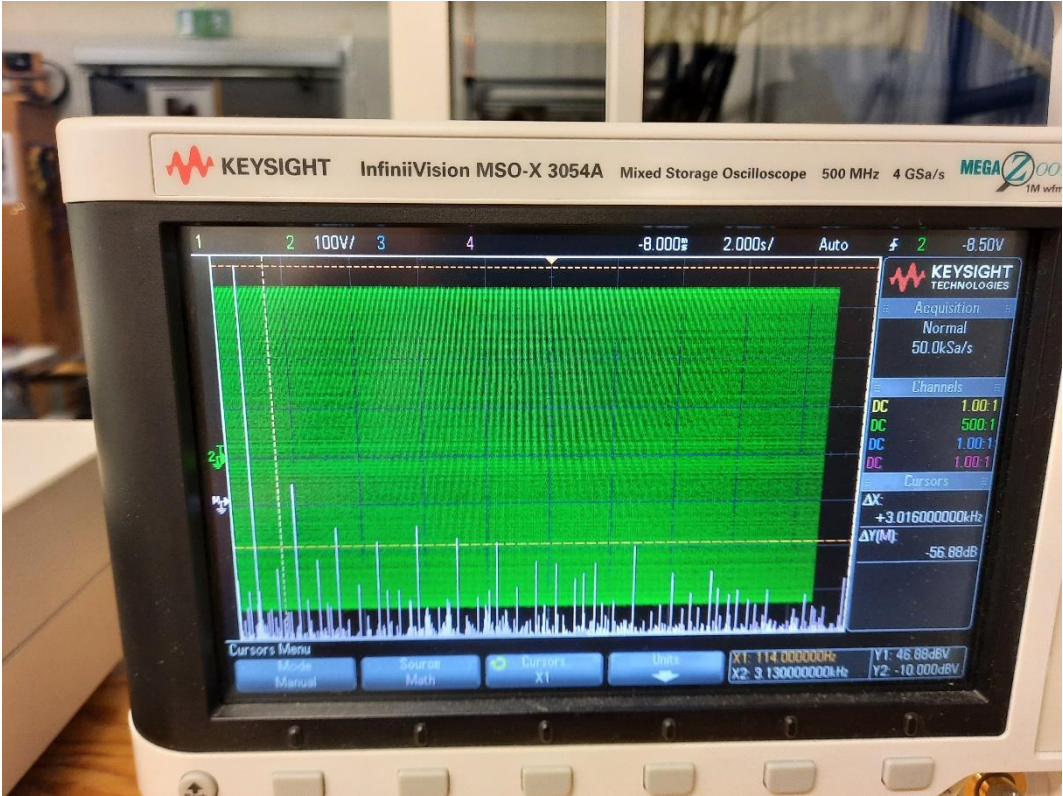
THD, with 550 W load:
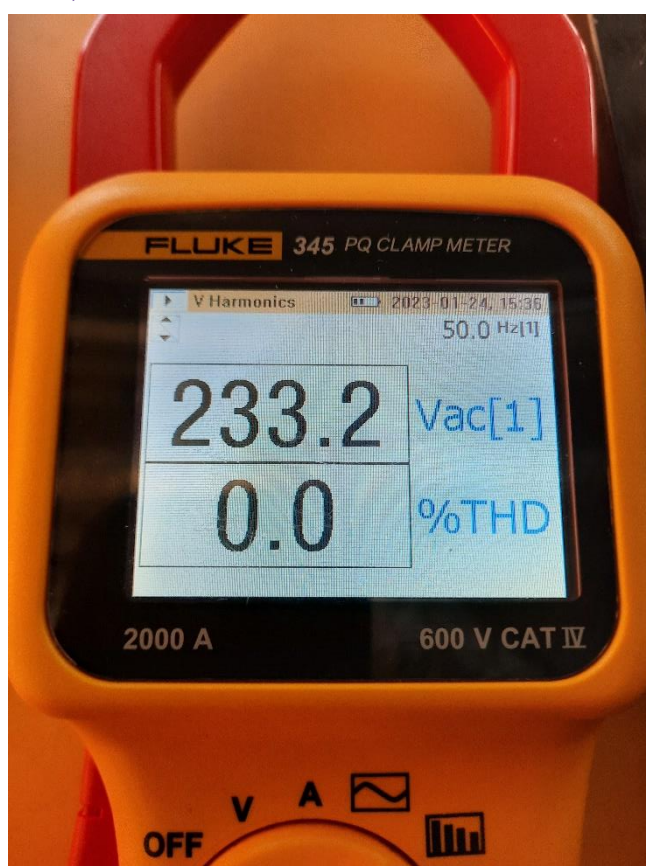
Waveshape, 550 W load:

4

FFT, 1800 W load:

THD, 1800 W load:

Waveshape, 1800 W load:
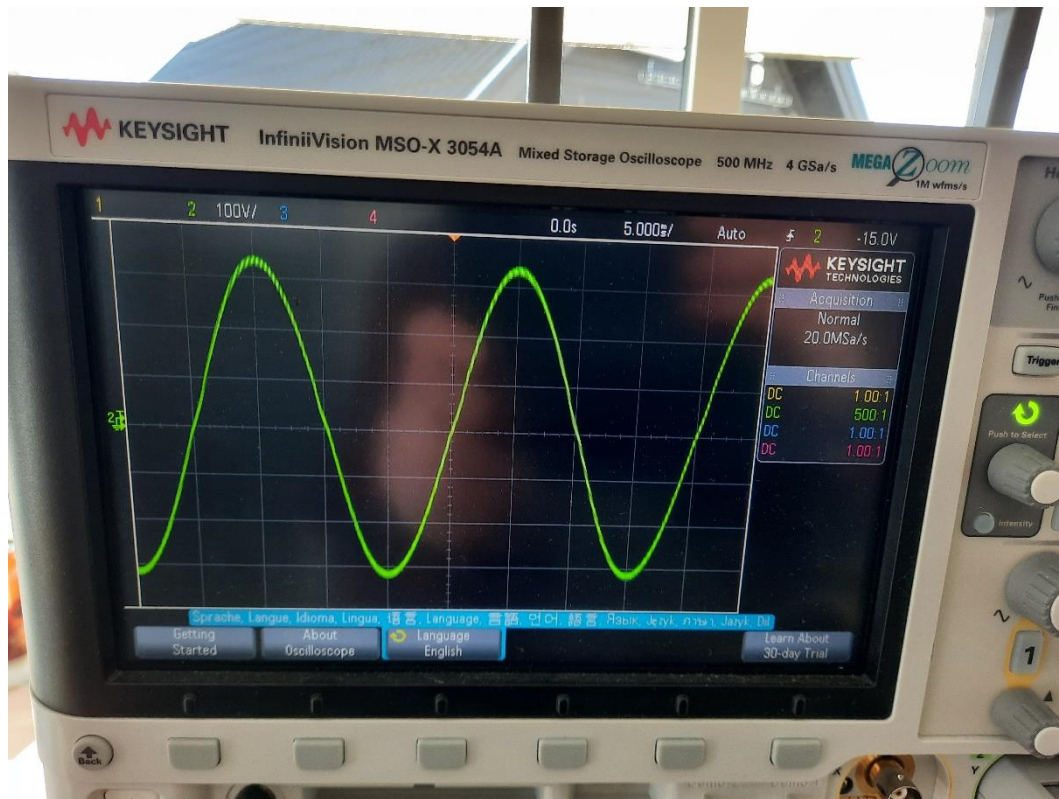
AC voltage level and frequency have been measured with multiple loads and monitored continuously during the cycle test. **The output voltage fluctuated between 225-235 V, frequency between 49,9-50,1 Hz**.

It can be concluded that the measured parameters fulfill the specification. This output AC power quality is adequate to run most of the available loads.

6. Functionality of supplementary DC/USB outlets

USB outputs as well as 12 V DC outputs have been tested for functionality. Both worked as specified.

7. Noise level

Noise level has been measured outdoors with the DB meter 1 meter and 4 meters away from the unit. The measurement was repeated with no load and the nominal load.

The results are as follows:

Load, W	Noise evel, db	
	1m	4m
0	76	67
1800	85	76

8. App functionality

Both units can be connected to a mobile device via app, both available for Apple and Android devices. Unit 2 has been tested with an Android application Gen-mate.

It worth mentioning the app is not continiously avaliable on Google Play Market, **there were periods of time diring testing when the app was not available**.

Installation of the app and connection to a unit require following steps of the supplied instruction manual. Mobile device is connected only via generators WiFi access point, thus **the range of usage is limited by WiFi range e.i. approx 20-30 meters**. **So it is not possible to control the device remotely from longer distance**. Another limitation with such a connection is that one should always manually reconnect from available Internet WiFi connection to the generator WiFi access point, which might be incenvenient for continious users.

Once the connection is established the app allows to monitor the generator performance parameters in oline mode, such as generated power, total generated energy, number of operated hours, maintenance interval, faulttracing etc. The app also allows to start* and stop the generator remotely.

*Since the start up of the cold generator require also manual pulling of the choke, the generator will only be able to start remotely when the engine is warm and when all switches and valves are in ON position.

9. 50 hours reliability test with nominal load

Unit 2 has been tested in total for 59 hours, among which for 53 hours with a nominal load of 1800 W. **Performance was compared before and after the test. No difference in performance or deviation from specified paramenters during the test has been detected.**

After about 30 hours of operation with nominal load, the unit stopped and indicated too low oil level in the engine. After filling about 100 ml of oil the test was continued. Thus, the unit does consume some oil. On the other hand, the manual specifies regular oil checks before each sparting procedure.

During the test it was also observed that the internal battery only last for some hours if the unit is left with the main switch in ON position after stopping. Also, if left with the main switch in OFF position, the battery fully discharged after a few weeks of standing without operation. Therefore, after long standing intervals, the unit with the electric started would either need to be started manually or require battery charge from external source.

The table below shows the testing days and times:

Date	Load	Hours	Fuel consumed	Fuel consumption
2023-01-23	550W	5,2	2,9	0,557692308
2023-01-30	1800W	4	4,1	1,025
2023-01-30	1800W	2,5		
2023-01-31	1800W	3		
2023-02-01	1800W	4		
2023-02-02	1800W	6		
2023-02-03	1800W	4		
2023-02-06	1800W	5,5		
2023-02-07	1800W	5,5		
2023-02-07	Failure stop: oil level. Added approx 100 ml.			
2023-02-09	1800W	5,5		
2023-02-13	1800W	7		
2023-02-28	1800W	2,5		
2023-03-01	1800W	4	4,1	1,025

10.   Conclusions

To summarize, the generator performed well in compliance to the manufacturer specification in the tests. Some comments can be related to the digital app with limited possibilities (due to manual choke it is not possible to perform a cold start remotely) and to the fact that the engine consumes some oil.

Appendix

SE 2000i(E) SPECIFICATIONS

DIMENSIONS AND WEIGHT

Overall Length	530mm (20.9 in)
Overall Width	320mm (12.6 in)
Overall Height	430mm (16.9 in)
Dry Weight	24kg / 26kg (53lbs /57lbs)

ENGINE

Type		4-stroke gasoline OHV
Cooling System		Forced air
Cylinder Arrangement		Inclined, single cylinder
Displacement		80cm³
Bore×Stroke		48.6mm×43.0mm (1.91 in×1.69 in)
Operation Hours		3.5Hr@rated load
		8Hr@1/4 rated load
Fuel		Unleaded gasoline
Fuel Tank Capacity		4.2L (1.11 US gal)
Engine Oil Capacity		0.35L (0.37 US qt)
Ignition System		CDI
Starting System		Recoil / Electric starter / APP starter
Spark Plug	Type	A5RTC (TORCH)
	Gap	0.6~0.7mm (0.024~0.028in)
Noise Pressure Level(L$_{PA}$) @ From 4m by CE standards		70dBA

GENERATOR

AC Output	Output Waveform	Pure-Sine Wave, THD <3%
	Rated Voltage*	100/110/120/220/230/240V
	Rated Frequency*	60/50Hz
	Rated Output	1.8kVA
	Maximum Output	2.1kVA
	Safety Device Type	Electronic
DC Output	Rated Voltage	12V
	Rated Current	8A
	USB	5V/2A/1A
	Safety Device Type	DC Protector

| NOTE |

(1). SE2000i is equipped with recoil starter, and SE2000iE with recoil starter & electric starter.

(2). The generator output specifications are based on the standard environment as follows:

- **Altitude: 0m**
- **Ambient temperature: 25℃**
- **Relative humidity: 30%**

***Specific parameters to see labels on the product.**