MEASUREMENT REPORT

5620A
08/10/2020

EMISSION MEASUREMENTS 22/9/2020

Rex Nordic Finland Oy

Airrex AH200i and AH300i

Report written by: Research Engineer Mikko Nykänen

Report reviewed by: Laboratory Technician Marko Piispa

SUMMARY

The flue gas emission measurements of Rex Nordic Finland Oy's AIRREX AH200i and AH300i oil heaters were performed 18/9–22/9/2020. A summary of the measurement results is presented in the table below.

Table 1 Summary of measurement results

Heater	Fuel	Measured component	Measured results		
			ppm	mg/m³n	mg/m³n red. O2 3%
AH200i	Biodiesel	CO	**1.5**	1.9	2.7
		NOx	**75**	154	221
		TVOC	**<0.1**	<0.1	<0.1
	Diesel	CO	**2.0**	2.5	3.6
		NOx	**69**	142	206
		TVOC	**<0.1**	<0.1	<0.1
AH300i	Biodiesel	CO	**1.0**	1.3	1.8
		NOx	**72**	148	208
		TVOC	**<0.1**	<0.1	<0.1
	Diesel	CO	**0.5**	0.6	0.9
		NOx	**64**	131	188
		TVOC	**<0.1**	<0.1	<0.1

1. CUSTOMER DETAILS

Customer: Rex Nordic Finland Oy

Address: Mustanlähteentie 24 A, 07230
Askola, Finland

2. PRODUCTS TESTED

Rex Nordic Finland Oy's AIRREX AH200i and AH300i diesel heaters were the subjects of the measurements. The identification data and images of the devices are provided in Annex 1.

3. PURPOSE OF THE MEASUREMENTS, MEASURED COMPONENTS AND THE FUEL USED

The purpose of the measurements was to find out the heaters' flue gas emissions with two different fuels. Biodiesel and diesel were used as the fuels. The biodiesel used is in Annex 2. The regular diesel was diesel from ST1.

Measured components:

- Concentration of nitrogen oxides (NOx)
- Carbon monoxide concentration (CO)
- Hydrocarbon concentration (TVOC)
- Oxygen concentration (O2)
- Carbon dioxide concentration (CO2)

In addition to the above, the amount and temperature of the gas was also measured.

4. IMPLEMENTATION OF THE MEASUREMENTS

The measurements were performed according to the following schedule:

18/09/2020	Installation and calibration of the measuring instruments. Pre-heating of the heaters. Measurements with biodiesel.
22/09/2020	Measurements with diesel.

Prior to the measurements, the heaters were pre-heated for approximately 60 minutes. The temperature set point was set to 30 °C. The heaters were functioning throughout the measurements, and the heaters' own measurement indicated a room temperature of about 25 °C.

5. MEASUREMENT RESULTS

5.1 RESULTS FROM EMISSION MEASUREMENTS OF AIRREXAH200i

The emission measurement results are presented in the table below. All concentrations are concentrations in dry gas.

Table 2 Average measurement results for O2 and CO2.

Fuel	O_2	O_2	CO_2	CO_2
	%	Uncertainty	%	Uncertainty
Biodiesel	**8.4**	± 0.2 % points	**8.7**	± 0.2 % points
Diesel	**8.6**	± 0.2 % points	**8.6**	± 0.2 % points

Table 3 Calculated CO, NOx and TVOC measurement results

Fuel	Component	ppm	mg/m3(n)		mg/m3(n) reduced O2 = 3%	
				Uncertainty		Uncertainty
Biodiesel	CO	**1.5**	**1.9**	± 10%	**2.7**	± 10%
	NOx	**75**	**154**	± 10%	**221**	± 10%
	TVOC	**<0.1**	**<0.1**	± 20%	**<0.1**	± 20%
Diesel	CO	**2.0**	**2.5**	± 10%	**3.6**	± 10%
	NOx	**69**	**142**	± 10%	**206**	± 10%
	TVOC	**<0.1**	**<0.1**	± 20%	**<0.1**	± 20%

NOx calculated as NO2.

Table 4 Other flue gas measurements.

Fuel	Flue gas temperature °C	Amount of flue gas m3(n)/s (dry)
Biodiesel	400	0.011
Diesel	382	0.011

Flue gas temperature was measured approximately 50 cm from the product's exhaust pipe.

5.2 RESULTS FROM EMISSION MEASUREMENTS OF AIRREX AH-300i

The emission measurement results are presented in the table below. All concentrations are concentrations in dry gas.

Table 5 Average measurement results for O2 and CO2.

Fuel	O_2	O_2	CO_2	CO_2
	%	Uncertainty	%	Uncertainty
Biodiesel	**8.2**	± 0.2 % points	**8.4**	± 0.2 % points
Diesel	**8.4**	± 0.2 % points	**8.8**	± 0.2 % points

Table 6 Calculated CO, NOx and TVOC measurement results

Fuel	Component	ppm	mg/Nm³		mg/Nm³ reduced O2 = 3%	
				Uncertainty		Uncertainty
Biodiesel	CO	**1.0**	**1.3**	± 10%	**1.8**	± 10%
	NOx	**72**	**148**	± 10%	**208**	± 10%
	TVOC	**<0.1**	**<0.1**	± 20%	**<0.1**	± 20%
Diesel	CO	**0.5**	**0.6**	± 10%	**0.9**	± 10%
	NOx	**64**	**131**	± 10%	**188**	± 10%
	TVOC	**<0.1**	**<0.1**	± 20%	**<0.1**	± 20%

NOx calculated as NO2.

Table 7 Other flue gas measurements.

Fuel	Flue gas temperature °C	Amount of flue gas Nm³/s (dry)
Biodiesel	377	0.009
Diesel	367	0.009

Flue gas temperature was measured approximately 50 cm from the product's exhaust pipe.

6. MEASUREMENT PERSONNEL AND CONTACT PERSONS

Laboratory Technician Marko Piispa and Research Engineer Mikko Nykänen from South-Eastern Finland University of Applied Sciences Ltd performed the measurements.

For more information about the measurements or results, please contact Mikko Nykänen, tel. +358447028255 or mikko.nykanen@xamk.fi.

7. DATA COLLECTION, MEASUREMENT RESULTS AND PROCESSING OF THE RESULTS

In gaseous measurements, the measurement data was collected on a data logger every 15 seconds. In one-off measurements, the data was recorded in a logbook. All calculations based on the measurement results were performed using Excel. The measurement results are only valid for the measured samples. The report can only be copied in its entirety. In any other cases, a written permission is required from the testing laboratory for copying.

8. REVIEW OF THE RESULTS

The testing can be considered successful. Both heaters functioned reliably throughout the measuring process, and no factors impacting the measurement results occurred during the measurements. Both heaters were pre-heated before carrying out the measurements.

8.1 MEASUREMENT UNCERTAINTY

The overall measurement uncertainty is calculated with Excel workbooks which have been created and validated for the purpose. The error analysis is performed based on probability calculation. All errors used represent a 95% confidence interval.

The following have been taken into account in calculating the measurement uncertainty:

- sampling errors (sample representativity)
- inaccuracy of analysers

Uncertainty is not calculated based on the variation in the measurement values. The uncertainties have been indicated in the measurement results.

8.2 INDOOR AIR CONDITIONS DURING MEASUREMENTS

Table 9 Outdoor air conditions during the measurements.

Measurement	22/09/2020	Unit
Temperature	22.4	°C
Pressure	101.7	Pa
Humidity	43	%

9. MEASURING METHODS AND INSTRUMENTS

The measuring instruments and methods are presented in the table below.

Table 10 Measuring instruments and methods.

Component	Method	Standard	Measuring device	Calibration gas
NOx	Chemiluminescence	SFS-EN 14792	HORIBA PG350	0 / 200 ppm
CO_2	IR absorption	ISO 12039	HORIBA PG350	0 / 13.0%
CO	IR absorption	SFS-EN 15058	HORIBA PG350	0/ 200 ppm
TVOC	FID	EN 12619	ERSATEC	0/ 30 ppm
O_2	Paramagnetic	SFS-EN 14789	HORIBA PG350	0 / 20.9%
Temperature		SFS-EN 13284	FLUKE thermo	
Flow		SFS-EN 13284	MIKOR TT570SV	

The laboratory of the South-Eastern Finland University of Applied Sciences Ltd / Kymilabs Emission Measurement Services is an accredited laboratory (T197). The accredited measurements are only valid for the measured ranges indicated below. If the result exceeds or falls below the range, the result is not accredited.

ANNEXES

Image 1 AIRREX AH200i

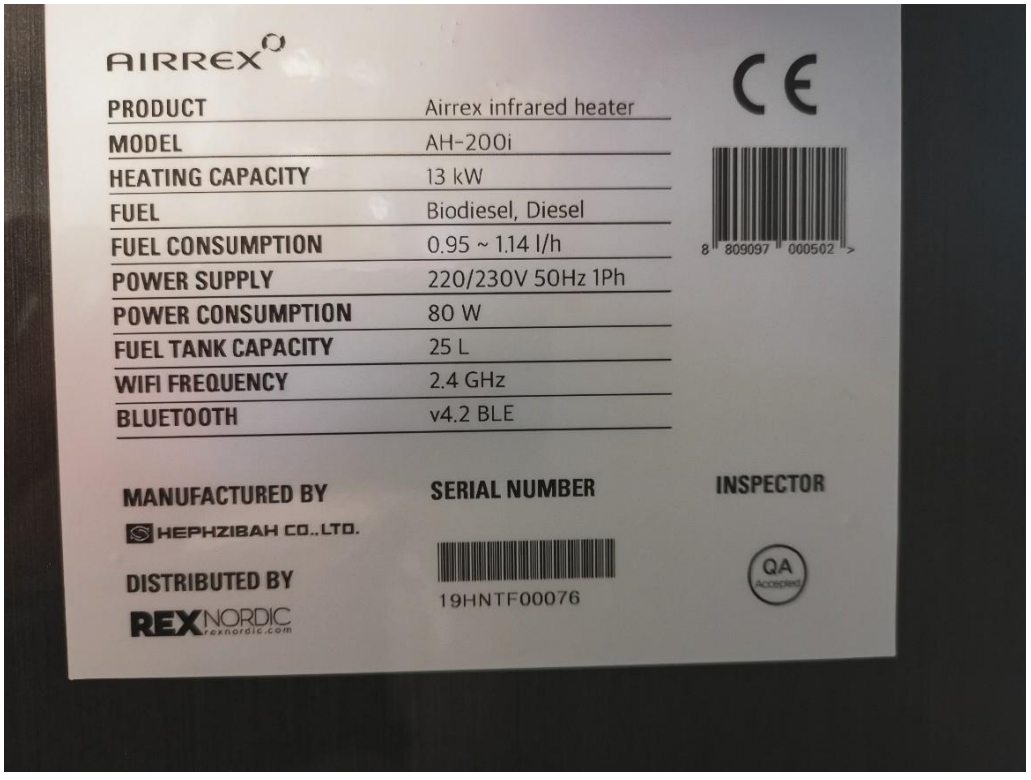

Image 2 AIRREX AH200i identification data

Image 3 AIRREX AH300i

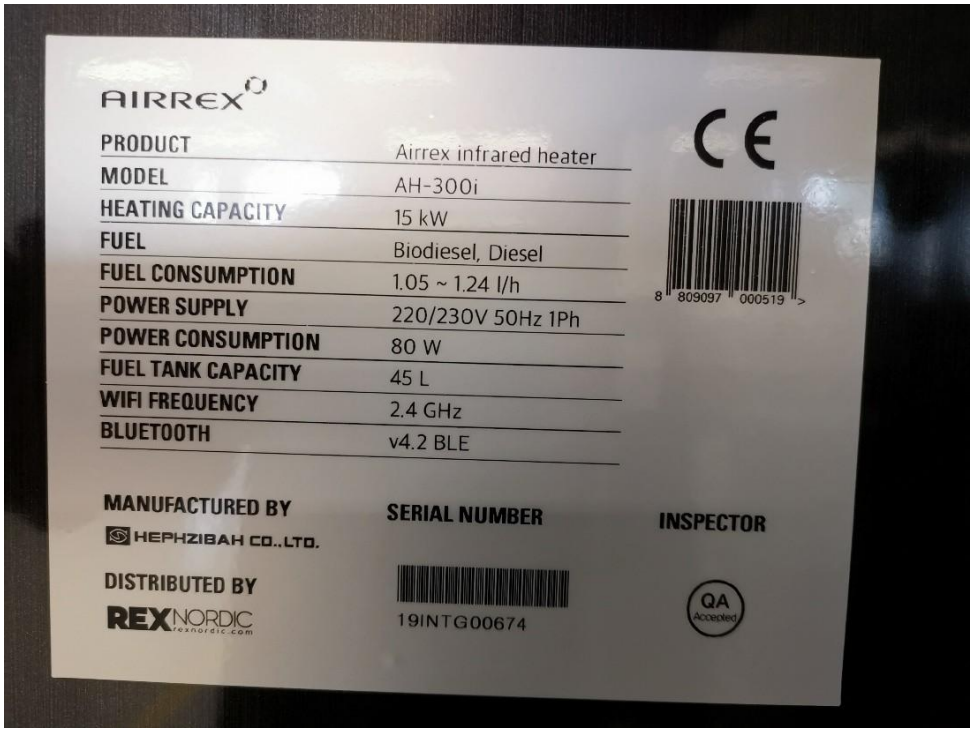

Image 4 AIRREX AH300i identification data

Image 1 The biodiesel used in the measurements