Found Space Trading Pty Ltd – Sauna Heater EMI/EMF Test
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Foreword

In September of 2017, Vitatech Electromagnetics, LLC defined a set of testing parameters and steps to simplify and standardize the measurement of electromagnetic emissions from sauna heating elements. These standardized procedures call for recording the electric and magnetic emissions from sauna heating at the surface of the heating element and at the closest distance that could be occupied near the heating element. The bandwidth for surveying the sauna heating elements was limited to 10 to 1,000 hertz for Alternating Current (AC) electric fields with a compact field analyzer and 10 to 4,000 hertz for a laboratory grade fluxgate magnetometer. Together these two sensor types provide a complete profile of the electromagnetic emissions of a sauna heating element. Note, the recorded measurements are only of the sauna heating element and **not** of the sauna in its installed configuration, actual electromagnetic field (EMF) exposure may differ from the measurements recorded during Vitatech's testing and that of the completed sauna.

Background

On October 15th, 2022, Electrical Engineer Tariq Dodoo, employed by Vitatech Electromagnetics LLC (Vitatech), recorded alternating current (AC) for frequencies from 10 Hertz to 1,000 Hertz to identify electromagnetic interference (EMI) generated by an unshielded sauna heater panel provided by Found Space Trading Pty Ltd (Found Space). Data was collected 15mm from the surface of the heater panel. Vitatech conducted the assessment in a magnetically shielded enclosure to ensure no external interference would be recorded during the measurements. The testing objective was to determine the magnitude of electromagnetic emissions that an individual would be exposed to during typical use within a sauna equipped with the heating panel. During testing the heater panel's current draw was 3.29 Amperes at 120 volts. Vitatech found and measured the location of the highest peak of electromagnetic emissions on the surface of the heater.

Table 1 shows the summary of the electromagnetic data recorded during this assessment and Image 1 illustrates the locations of the measurements.

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Image 1: Measurement Locations

		Electric Field (E-Field) [V/m RMS]	Magnetic Field (B-Field) [mG RMS]
Sensor Type		Narda EHP-50D	Sensys FGM3D-SV 4kHz
Frequency Range		10 to 1,000 Hz	10 to 4,000 Hz
Location	1 15 mm from surface	26.563 V/m RMS	2.06 mG RMS
	2 15 mm from surface	31.71 V/m RMS	0.67 mG RMS
	3 15 mm from surface	372.77 V/m RMS	1.41 mG RMS
	4 15 mm from surface	743.45 V/m RMS	0.79 mG RMS
	5 15 mm from surface	800.21 V/m RMS	0.40 mG RMS
	6 15 mm from surface	57.95 V/m RMS	1.97 mG RMS

Table 1: Summary of measurements from heating panel (including supply wires, etc.)
Red indicates the maximum value recorded during testing.

Conclusions

The average values for the Found Space heater panel were less the maximum thresholds listed in EN 55035:2017 of 1 A/m (12.57 mG RMS) for 60 Hz magnetic fields and less than the standard IEEE 95.6:2002 of 5,000 V/m for whole body exposure to electric fields. Though there are recommendations for an individual's exposure to electromagnetic fields, there are no Australian regulations nor laws regarding the maximum permissible exposure. The peak electric field level for the heater panel was recorded at location #5 and the peak magnetic field at location #1. These values were 800.21 V/m RMS from 10 to 1,000 Hertz, and 2.06 mG RMS from 10 to 4,000 Hertz respectively.

This completes Found Space Trading Pty Ltd – Sauna Heater EMI/EMF Test– Electromagnetic emissions documentation and assessment. For questions regarding this assessment, please contact Found Space Trading Pty Ltd directly.

Survey Equipment

NARDA EHP-50D

The NARDA EHP-50D records electric field strength in Volt-per-meter(V/m) and magnetic field strength in micro-Tesla (µT) from one (1) hertz to one-hundred thousand hertz (100 kHz). With a measurement range of 5 mV/m to 1 kV/m for electric fields and 0.3 nano-Tesla to 100 micro-Tesla for magnetic fields. The EHP-50D system when used with the EHP-TS software interface has a resolution of 0.1 mV/m for electric fields and 0.1 nT for magnetic fields.

Table 1-1 Technical specifications of the EHP-50D Electric and Magnetic Field Analyzer

	Electric Field	Magnetic Field
Frequency range	5 Hz ÷ 100 kHz	
Measurement range (1)	5 mV/m ÷ 1 kV/m 500mV/m ÷ 100 kV/m (146 dB)	0.3 nT ÷ 100 µT 30 nT ÷ 10 mT (150 dB)
Overload	200 kV/m	20 mT
Dynamic range	106 dB	110 dB
Resolution (2)	1 mV/m with NBM-550 0.1 mV/m with EHP-TS SW 1 mV/m Stand alone	0.1 nT with NBM-550 0.1 nT with EHP-TS SW 1 nT Stand alone
Displayed average noise level (3) **Isotropic result** **Single axis**	 5 mV/m 3 mV/m	 0.3 nT 0.2 nT
Flatness (@ 100 V/m and 2 µT) **(5 Hz ÷ 40 Hz)** **(40 Hz ÷ 100kHz)**	 0.8 dB 0.35 dB	 0.8 dB 0.35 dB
Anisotropicity	0.54 dB	0.12 dB
Linearity (referred to 100 V/m and 1 µT)	0.2 dB (1 V/m ÷ 1 kV/m)	0.2 dB (200 nT ÷ 10 mT)
Internal memory	Up to 24 hours regardeless the logging rate.	
Internal data logger	1 measurement every 30 or 60 seconds	
Spectrum analysis method	FFT	
Acquisition method	Simultaneous three axis acquisition	
SPAN	100 Hz, 200 Hz, 500 Hz, 1 kHz, 2 kHz, 10 kHz, 100 kHz (500Hz to 100kHz in Stand Alone mode)	
Start frequency	1.2 % of the SPAN	
Stop frequency	Equal to the SPAN	
Rejection to E fields	---	> 20 dB
Rejection to H fields	> 20 dB	---
Calibration	internal E^2PROM	
Typical temperature deviation @ 55 Hz referred to 23°C (@ 50% of relative humidity when applicable)	$-4x10^{-3}$ dB/°C between -20 and +55 °C	$-8x10^{-3}$ dB/°C between -20 and +23 °C $+13x10^{-3}$ dB/°C between 23 and 55 °C
Typycal relative humidity deviation @ 55 Hz referred to 50% (@ 23 °C)	$+11x10^{-3}$ dB/% between 10 and 50 % $+22x10^{-3}$ dB/% between 50 and 90 %	$-7x10^{-3}$ dB/% between 10 and 50 % $+10x10^{-3}$ dB/% between 50 and 90 %
Dimensions	92 x 92 x 109 mm	
Weight	550 g	
Tripod support	Threaded insert ¼"	
Internal battery	3.7 V / 5.4 Ah Li-Ion, rechargeable	

Sensys FGM3D - 4kHz – Three Axis Magnetometer

Sensys FGM3D-4kHz special low noise version 3-axis fluxgate magnetometers were used to collect magnetic flux density levels. The Sensys have a maximum range of ±1 Gauss (±100 µT), a bandwidth of 0 Hertz to 4,000 Hertz (to the -3 dB), a resolution of <70 pT, and a noise level of <8 $pT_{RMS}/\sqrt{Hz}$. Three channel AC ELF and DC EMI data from the fluxgate probes were sampled at 10,240 Hz with a National Instruments (NI) 24 bit USB-4432 A/D system and processed/stored by a custom design NI evaluation program that displays the peak-to-peak AC ELF and DC three-axis Bx, By and Bz data in units of milligauss (mG), and, provides a Fast Fourier Transform (FFT) analysis in units of RMS of the AC power harmonic content. 24-bit A/D and portable computer.

Technical data FGM3D/100

	Standard	Special version	
Measurement range	**±100,000 nT**	**±100,000 nT**	
Point of reference single axes	See below (14.5/34.5/54.5 from reference edge)		
Point of reference total intensity	34.5mm		
Declination between axes	≤ ±0,5°	≤ ±0,1°	
Declination total	≤ ±1°	≤ ±0,12°	
Resolution	< 150 pT	< 70 pT	
Noise	< 15 $pT_{rms}/\sqrt{Hz}$	< 8 $pT_{rms}/\sqrt{Hz}$	@ 0,1 ... 10 Hz
Cut off frequency (bandwidth)	4 kHz (DC…4 kHz)		
Temperature drift	<0.3 nT/K		
Drift over time	t.b.d.		
Zero error	≤ ±5 nT		
Stability	< 5 nT		
Linearity	±2 nT / < 20 ppm		
Compensation range	n.a.		
Sensitivity	0,1 V/µT		