

## CASE STUDY KIWA – APELDOORN, THE NETHERLANDS



To service a growing market boosted by advances in IoT technology, Kiwa invested in expanding their test capabilities with the construction of a new EMC Test Facility. Kiwa selected ETS-Lindgren as their preferred supplier due to the company's status as a leader in the EMC Chamber industry as well as its reputation for high quality products. Historically, Kiwa was well-known for EMC testing of gas and electrical products in the cooking, catering, and heating markets, including heat pumps and boilers. Today, Kiwa tests a very broad scope of products with the developments in IoT. With the new EMC Test Chambers, Kiwa can test a wide variety of products with wireless communication capabilities.

### Overview

ETS-Lindgren designed and installed several EMC test chambers to offer full compliance Radiated Emissions (RE) and Radiated Immunity (RI) measurements, as well as Conducted Transients, Conducted Emissions, ESD, and Radio Testing. The primary chambers included a fully compliant 5-meter Semi-Anechoic Chamber (SAC) and a 3-meter Fully Anechoic Room (FAR) which included supporting chambers for use as Operator Rooms, Auxiliary Equipment Rooms, and a shared Amplifier Room.

### Building Information Modeling (BIM)

To increase productivity and build smarter, better anechoic chambers, ETS-Lindgren utilized BIM software during the design of this multi-chamber project. BIM is a collaborative tool that results in lower expense and risk; fewer construction delays and rework; as well as a decrease in on-site problems – all of which ensured

the Kiwa EMC Test Facility project would stay on schedule. With BIM, the manufacturing team, construction crew, general contractor, architect, and customer viewed a 3D model of the multiple chambers. The 3D representations showed the mechanical, electrical, and plumbing as well as the architecture. BIM revealed the support steel columns of the parent building. The columns restricted the size of the space available and presented a design challenge for the 5-meter chamber. ETS-Lindgren's customized chamber design accommodated the steel support columns; modeling of the chamber performance confirmed the design met the RF performance required. Recommendations about the interface of the anechoic chambers and RF shielded enclosures with the parent building were also part of ETS-Lindgren's BIM review with the customer. This thorough review of the connection of the new chambers to the parent building ensured a successful project outcome.

### **Full Compliance FACT™5 SAC (Performance to 40 GHz)**

ETS-Lindgren designed, manufactured, and installed a FACT 5 (Freespace Anechoic Chamber Testsite). Model FACT 5 is a full compliance 5-meter chamber with a 3-meter Quiet Zone (QZ) suitable for RE and RI testing in accordance with most international EMC standards. It achieves broadband performance using a unique, optimized arrangement of hybrid and ferrite tile absorber material. ETS-Lindgren's FACT 5 provides the highest shielding effectiveness performance available on the market to 125 dB up to 40 GHz.

#### Key Features:

- Nominal internal shield-to-shield chamber dimensions of 11.7 m L x 6.7 m W x 5.5 m H (38 ft L x 22 ft W x 18 ft H) – prior to absorber installation.
- Constructed of Series 101 panel-type 2 mm (.07 in) galvanized steel panels, bolted from the inside, which are 100% dismountable and transferable.

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- Fully automatic sliding door, Model RFSD-F/A-100, with clear opening of 3 m W x 3 m H (10 ft W x 10 ft H) with automatic lifting platform to allow level access into the chamber.
- Personnel access door, swing type, Model RFD-F/A-100, with clear opening of 0.9 m W x 2.1 m H (3 ft W x 7 ft H).
- Built-in turntable, flush with ground plane, 3 m (10 ft) diameter, 4,000 kg (8,800 lb) max permissible load.
- Electrical package included LED lighting and power.
- Turnkey chamber accessories included power line filters, penetration panels, waveguide air vents, and CCTV 4340 camera system.

### Absorber

The ETS-Lindgren DuraSorb™ absorber provided features a smooth transition from free space impedance to the lossy ferrite tile base. The tiles are individually screwed onto internal under-construction, so they can be dismounted for future chamber transfer. As a result of its optimized design for EMC measurements, high performance is guaranteed not only at the lower frequency band, but also at above 1 GHz. It has a reflectivity better than 17 dB from 60 MHz to 3 GHz, and better than 20 dB at above 4 GHz. At frequencies above 8 GHz, the reflectivity

exceeds 35 dB. The absorption levels make DuraSorb ideal for 3- and 5-meter range measurements in semi-anechoic chambers per the CISPR 16 and ANSI C63.4 standards. It also meets the requirements of the MIL-STD-461 and CISPR 25 standards. DuraSorb is 100% RF tested at ETS-Lindgren prior to shipment; each piece of absorber has a serial number which offers full traceability.

Ceiling and walls included full coverage with ferrite tiles with optimized coverage of 600 mm (2 ft) DuraSorb Model DSH-600H volumetrically loaded polystyrene absorber, including white end caps. A set of floor absorbers was provided for RI testing according to IEC 61000-4-3. The set consisted of 16 wheeled ferrite carts with DSH-600H hybrid absorber, located between the field generation antenna and the uniform field area. The total surface area was 2.4 m x 2.4 m (7.8 ft x 7.8 ft). Twenty-eight pieces of Model EHP-12PCL-FX volumetrically loaded polyurethane absorber with a FlexSorb™ coating were also provided for RE testing above 1 GHz.

### Chamber and Absorber Performance Testing

Final chamber performance testing was conducted by an independent, ISO 17025 accredited laboratory. The shielding effectiveness testing was performed in accordance with EN50147-1 at five test frequencies (10 kHz,

100 kHz, 1 MHz, 1 GHz, and 40 GHz) at five locations inside the chamber.

The Absorber Performance Test Plan included:

- Normalized Site Attenuation (NSA) according to CISPR 16-1-4, 30 MHz – 1 GHz, 3 m (10 ft) QZ diameter at 5 m (16 ft) distance, and 2 m (6.5 ft) QZ diameter at 3 m (10 ft) distance. Test results confirmed performance at +/-3.5 dB, exceeding basic expectations.
  - Site VSWR (sVSWR) according to CISPR 16-1-4, 1 GHz – 18 GHz, 2 m (6.5 ft) QZ diameter at 3 m (10 ft) distance.
  - Field Uniformity according to EN/IEC 61000-4-3, 80 MHz – 6 GHz.
- Full Compliance 3-Meter FAR (Performance to 40 GHz)**
- ETS-Lindgren designed and manufactured a 3-meter FAR suitable for RE and RI testing in accordance with most international EMC standards. ETS-Lindgren's 3-meter FAR provides the highest shielding effectiveness performance available on the market to 125 dB up to 40 GHz.
- Key Features:**
- Nominal internal shield-to-shield chamber dimensions of 8.35 m L x 4.83 m W x 3.87 m H (27 ft L x 16 ft W x 13 ft H) – prior to absorber installation.
  - Constructed of Series 101 panel-type 2 mm (.07 in) galvanized steel panels as noted above.

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- RF Shielded Doors: Model RFD-F/A-100 for EUT access door (between SAC and Laboratory); semi-automatic single leaf swing door with clear opening of 1.5 m W x 2.1 m H (5 ft W x 6.8 ft H) with automatic lifting platform to allow level access in to the chamber.
- Built-in turntable, flush with ground plane, 1.5 m (5 ft) diameter, 2,000 kg (4,400 lb) max permissible load.
- CISPR 25 Ed. 4 compliant test bench, 3 m L x 1.2 m W x 0.9 m H (10 ft L x 4 ft W x 3 ft H), including ground straps and galvanized steel ground plane on the top surface.
- Turnkey chamber accessories included electrical package for lighting and power, power line filters, penetration panels, waveguide air vents, and CCTV 4340 camera system.

### Absorber

The ceiling and walls of the FAR chamber included full coverage with ferrite tiles and 600 mm (2 ft) DuraSorb Model DSH-600H volumetrically loaded polystyrene absorbers, including white end caps. On the chamber floor, full coverage was provided with ferrite tiles, including a suitable protective floor covering. The floor installation included 16 pieces of DuraSorb Model DSH-600H absorbers for RI testing and 25 pieces of Model EHP-12PCL-FX volumetrically loaded polyurethane absorber with a FlexSorb coating for RE testing above 1 GHz.

### Chamber and Absorber Performance Testing

Final chamber performance testing was conducted by an independent, ISO 17025 accredited laboratory. The shielding effectiveness testing was performed in accordance with EN50147-1 at five test frequencies (10 kHz, 100 kHz, 1 MHz, 1 GHz, and 40 GHz) at five locations inside the chamber.

The Absorber Performance Test Plan included:

- FSNSA according to CISPR 16-1-4, 30 MHz – 1 GHz, 1.5 m (5 ft) QZ diameter at 3 m (10 ft) distance. Test results confirmed performance at +/-4 dB, meeting expectations.
- sVSWR according to CISPR 16-1-4, 1 GHz – 18 GHz, 1.5 m (5 ft) QZ diameter at 3 m (10 ft) distance.
- Field Uniformity according to EN/IEC 61000-4-3, 80 MHz – 6 GHz.

### Support Chambers

ETS-Lindgren provided several support chambers for various types of EMC testing, including:

- 6 m x 3 m x 2.6 m (20 ft x 10 ft x 8.5 ft) Operator Rooms for 5-meter SAC and 3-meter FAR.
- 2 m x 3 m x 2.6 m (6.5 ft x 10 ft x 8.5 ft) Auxiliary Rooms for 5-meter SAC and 3-meter FAR.
- 4 m x 3 m x 2.6 m (13 ft x 10 ft x 8.5 ft) Amplifier Room (shared between 5-meter SAC and 3-meter FAR).

- 4 m x 5 m x 2.6 m (13 ft x 16 ft x 8.5 ft) Shielded Room (Conducted Transients).
- 4 m x 5 m x 2.6 m (13 ft x 16 ft x 8.5 ft) Shielded Room (Conducted Transients).
- 3.4 m x 3 m x 2.6 m (11 ft x 10 ft x 8.5 ft) Shielded Room (Conducted Emissions).
- 3.4 m x 3 m x 2.6 m (11 ft x 10 ft x 8.5 ft) Shielded Room (ESD Testing).
- 5 m x 5 m x 2.6 m (16 ft x 16 ft x 8.5 ft) Shielded Room (Radio Testing).

### About ETS-Lindgren

ETS-Lindgren is an international manufacturer of components and systems that measure, shield, and control electromagnetic and acoustic energy. The company's products are used for electromagnetic compatibility (EMC), microwave and wireless testing, electromagnetic field (EMF) measurement, radio frequency (RF) personal safety monitoring, magnetic resonance imaging (MRI), and control of acoustic environments.

Headquartered in Cedar Park, Texas, ETS-Lindgren has manufacturing facilities in North America, Europe, and Asia. Additional information about ETS-Lindgren is available at [www.ets-lindgren.com](http://www.ets-lindgren.com). Additional information about ETS-Lindgren's parent company ESCO and its subsidiaries is available at [www.escotechnologies.com](http://www.escotechnologies.com).