Absorber Technology
Principles of EMC, Necessity of Absorbers

Principles of EMC
Electromagnetic compatibility (EMC) is the branch of electrical sciences, which studies the unintentional generation, propagation, and reception of electromagnetic energy with reference to the unwanted effects (Electromagnetic Interference (EMI) or Electromagnetic Susceptibility (EMS)) that such energy may induce. EMC aims to ensure that equipment, items or systems will not interfere with or prevent each other’s correct operation through spurious emission and absorption of electromagnetic energy.

**EMI (Emission):** Verification of what the EUT generates in term of electromagnetic energy emitted to the environment.
**EMS (Immunity/Susceptibility):** Verification of what the EUT will receive of electromagnetic energy to prevent malfunctions.
These tests must be done in a perfect and standardized environment in order to avoid any external influence. Laws and standards limit EMI and EMS values.

Anechoic Chamber:
Due to the disadvantages of OATS and the increasing standards in EMC testing’s, an EMC chamber offer a lot of advantages:
- Reduced testing time and costs
- Volumetric site attenuation
- Greater reproducibility, resolution and reliability
- Respecting and considering standards
- Test setup always ready without weather influence in humidity or temperature
- Confidentiality and access limitations
- Correlation with others laboratories and standards

OATS – Open Area Test Site:
The OATS are the reference sites in most of existing standards. They are especially useful for emissions testing of large equipment systems. Unfortunately, the OATS test has a lot of disadvantages:
- Weather conditions need to be respected
- Access to isolated sites outside of cities
- Confidentiality problems
- Complex setup
- Perturbed environment, maintenance and transportation
- Test time, unsecure quality, weak reproducibility

Necessity of Absorbers
We should test emission (EMI) and immunity (EMS) inside a reflective but shielded environment. However, the shielding will reflect any electromagnetic fields generated by an antenna or any interference generated by the device under test (EUT). Within such an environment, there is no chance to measure correctly. That is why the inside of a shielded room needs absorbers covering ceiling and walls (semi) or in case also the floor (fully). The goal within an anechoic chamber is to define a Quiet Zone (QZ) somewhere located in the chamber, where radiated standards in a validated testing environment acc.to CISPR 16–1–4 for EMI and IEC/EN 61000-4-3 for EMS are guaranteed. Only through the right definition and configuration of absorbers, as well as the physical correct size of the chamber, a QZ can be generated.

While respecting the standard, an EMC environment is a very complex scenario. That is why the Quiet Zone for the whole frequency range cannot be calculated or simulated.
Absorber Technology
Materials, Types, Frankosorb®

Materials
Polyurethane Foam Absorbers (open cell):
Impregnated foam cell in a mixture with carbon, technology from 1950s, small sized, cheap by easy manufacturing, less quality and stability, only in combination with Ferrite, dangerous and harmful substances, flammability and toxic gases through carbon, unstable performance, refurbishment after 10–15 years necessary

Polystyrene Absorbers (closed cell):
Carbon injected in polystyrene material, technology from 1970s, less carbon, good homogeneity, expensive, only in combination with Ferrite, customized shapes, flammability and toxic gases through carbon

Thin-film Nano Technology Absorbers (Frankosorb®):
Carbon free, developed in 1991 by Frankonia, very good homogeneity, non–combustible, cleanroom absorber, no Ferrite necessary, covers the whole frequency range in the long version, recyclable, harmless, stable and guaranteed performance characteristic for more than 25 years

Benefits of Frankosorb®
The Frankonia’s Frankosorb® absorber technology combines a variety of high-performance standards in a single solution. Due to its unique method, Frankosorb® technology is available either as a hybrid solution in combination with ferrite absorbers, or as a standalone pyramid solution with a length up to 2.5 m.

Key facts:
- Long-lasting guaranteed absorber performance and stability
- Non–combustible according to DIN EN 13501–1 (DIN 4102) Class A2, or
- Non–inflammable according to DIN EN 13501–1 (DIN 4102) Class B1 and B2
- High power handling absorbers A2 absorbers: 2 kW/m2 or 850 V/m (continuous duty); 3.5 kW/m2 or 1,150 V/m (intermediate power) B1/B2 absorbers: 1 kW/m2 or 600 V/m (continuous duty); 2.6 kW/m2 or 1,000 V/m (intermediate power)
- High absorption capability
- Humidity–proof
- Proven performance characteristics ensure reproducible results
- Guaranteed performance for a minimum of 10 years
- Damage–proof
- No dirt, carbon smell or dust
- Easy to clean and washable
- Clean room classification according to ISO 14644–1 Class 5
- No aging or drooping
- Space-saving and stackable floor absorbers
- Easy installation without using glue or other harmful substances
- White coloring that improves the illumination level
- Easily removable, fixation either by screw or hanging type

Types of Absorbers
Ferrite Absorbers:
Flat absorbers, covers a frequency range from 30 MHz to 1 GHz

Pyramid Absorbers:
Depending on the physical length, it covers the complete frequency range from 30 MHz up to 40 GHz, or more

Hybrid Absorbers:
Ferrite absorbers and additional short pyramid absorbers to extend the frequency range from 30 MHz up to 40 GHz, or more
## Absorber Technology
### Comparison, Uniqueness of Frankosorb®
#### Comparison of Absorber Materials

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Polyurethane Foam Absorbers</th>
<th>Polystyrene Absorbers</th>
<th>Thin-film Nano Technology Absorbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Mechanical strength</td>
<td>Weak</td>
<td>Strong</td>
<td>Very strong</td>
</tr>
<tr>
<td>Accuracy, Reproducibility, and Homogeneity</td>
<td>Weak</td>
<td>Good</td>
<td>Very good</td>
</tr>
<tr>
<td>White covering</td>
<td>No (yes with caps)</td>
<td>No (yes with caps)</td>
<td>Yes</td>
</tr>
<tr>
<td>Non-inflammable</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Non-combustibility</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Hazardous substances</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Toxic gases in case of fire</td>
<td>Yes</td>
<td>Yes (litter)</td>
<td>No</td>
</tr>
<tr>
<td>Performance loss over years</td>
<td>Yes</td>
<td>Case by Case</td>
<td>No</td>
</tr>
<tr>
<td>Fixation by glue</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixation with hangers or screws</td>
<td>No</td>
<td>Case by Case</td>
<td>Yes</td>
</tr>
<tr>
<td>Humidity resistance</td>
<td>Weak</td>
<td>Good</td>
<td>Very good</td>
</tr>
<tr>
<td>Dropping tips (aging)</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Impedance matching</td>
<td>Problematic with hybrid absorbers</td>
<td>Problematic with hybrid absorbers</td>
<td>Uncomplicated with long pyramids</td>
</tr>
</tbody>
</table>

### Characteristic

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Polyurethane Foam Absorbers</th>
<th>Polystyrene Absorbers</th>
<th>Thin-film Nano Technology Absorbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Companies</td>
<td>ETS–Lindgren, Albatross, E&amp;C, Rikken, Tokin, Siepel, MVG</td>
<td>TDK, Comtest (copy of TDK), ETS–Lindgren (copy of TDK)</td>
<td>Frankonia</td>
</tr>
<tr>
<td>Price</td>
<td>Cheap</td>
<td>Very expensive</td>
<td>Expensive</td>
</tr>
<tr>
<td>Hybrid Absorbers</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Long-pyramid Absorbers</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Long-pyramid Absorbers for complete frequency range</td>
<td>No</td>
<td>No</td>
<td>Yes (without Ferrite)</td>
</tr>
<tr>
<td>Lifespan</td>
<td>Weak</td>
<td>Good</td>
<td>Very good</td>
</tr>
<tr>
<td>Removable</td>
<td>Weak</td>
<td>Good</td>
<td>Very good</td>
</tr>
<tr>
<td>Recyclable</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Customers</td>
<td>Electrics, Military, Aerospace</td>
<td>Electrics, Military, Automotive, Aerospace</td>
<td>Electrics, Military, Automotive</td>
</tr>
<tr>
<td>Cleanroom capability</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Technology from</td>
<td>1950s</td>
<td>1970s</td>
<td>1991</td>
</tr>
</tbody>
</table>

### Uniqueness of Frankosorb®

For example, Frankonia to date is the unbeaten solution provider in the technology driven field of EMC testing of the automotive industry. The reason is simple: The Frankosorb® absorber technology offers a stable, reproducible and high-quality absorber solution for large chambers.

A bit higher investment in non-combustibility compare to the value of a car prototype is therefore irrelevant. Inverse, imagine the costs for a fire extinguishing system with annual maintenance costs. Thus, a higher first investment turns into a cost saving solution in the long-turn. Furthermore, Frankonia offers complete and high-end solutions and is taking over the complete project responsibility.