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through inventive engineering

Case Study: Test Fixture for ASTM D 4935-10 Shielding Effectiveness

Client: Electronics system enclosure design

Client Problem: Needed to measure the electromagnetic (EM) shielding effectiveness of polymeric materials filled with electrically conductive metal fibers. The measurements were to be taken using various polymeric base materials filled with various types and filler loadings of conductive metal fibers over a range of thicknesses from 0.025” to 0.250”.

GEOMETRIXDESIGN Solution: Due to the large design matrix consisting of:

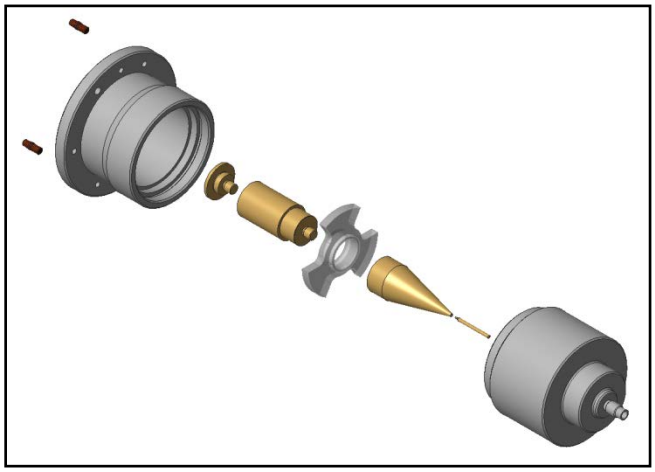
- Polymeric material type
- Electrically conductive filler type
- Electrically conductive filler loading
- Polymeric material thickness

a two-fold solution was developed to provide efficiency in implementing and obtaining the shielding effectiveness measurements:

1. Use the ASTM Standard D 4935-10 test method for measurement of the EM shielding effectiveness of a planar material due to a normal incidence, far-field, plane-wave
2. Use an injection molding process to mold the metal fiber filled polymeric materials into test plaques for use in the test method in 1.

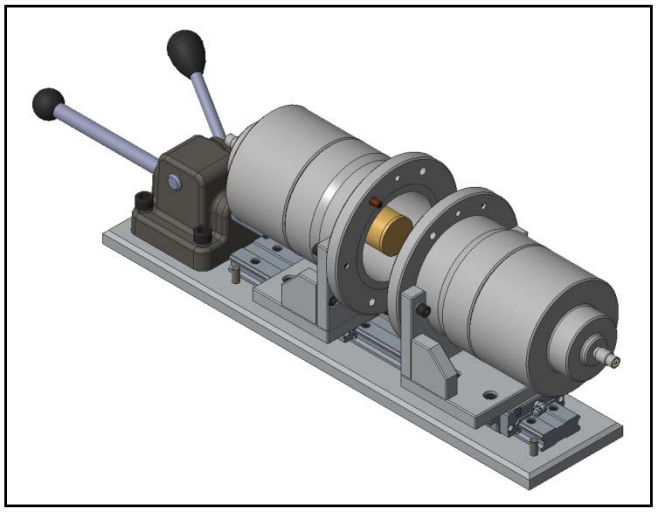
Design Details: The test method of ASTM Standard D 4935-10 utilizes a test fixture that supports flat test specimens. The test fixture is an enlarged coaxial transmission line with two tapered conductors that provide shielding effectiveness measurements over a frequency range of 30MHz to 1.5GHz. A signal generator that produces a sinusoidal signal over this frequency range and a receiver for measuring this signal are connected to each end of the test fixture. Flat test specimens for both reference and load are mounted between the tapered sections.

The ASTM Standard D 4935-10 provides general design specifications for the test fixture and reference and load specimens. Due to the weight and size of the conductors, a carriage rail system was designed to support the test fixture and provide quick



Exploded assembly model of tapered conductor

insertion, clamping, and measurement of the large number of reference and load test specimens. A complete set of detailed component drawings with full tolerances, material and plating specifications were created for fabrication.



Model of test fixture conductors with carriage rail system and clamp

The test fixture and carriage rail system are available for purchase from Geometrix Design at info@geometrixdesign.com

To implement the injection molding process for manufacture of the large quantity of test plaques needed for the shielding effectiveness measurements, an injection

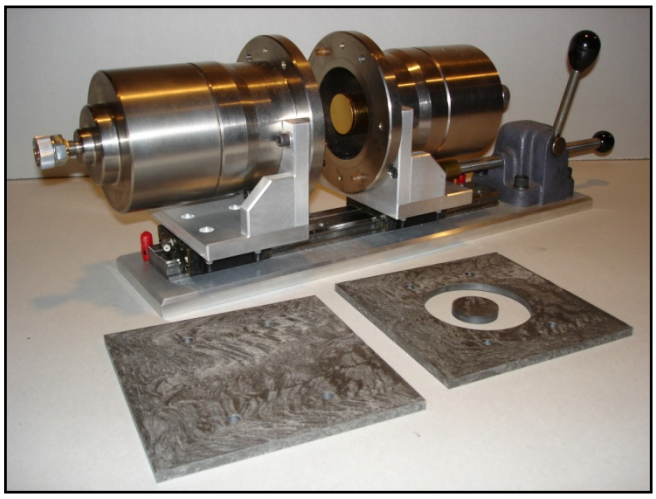
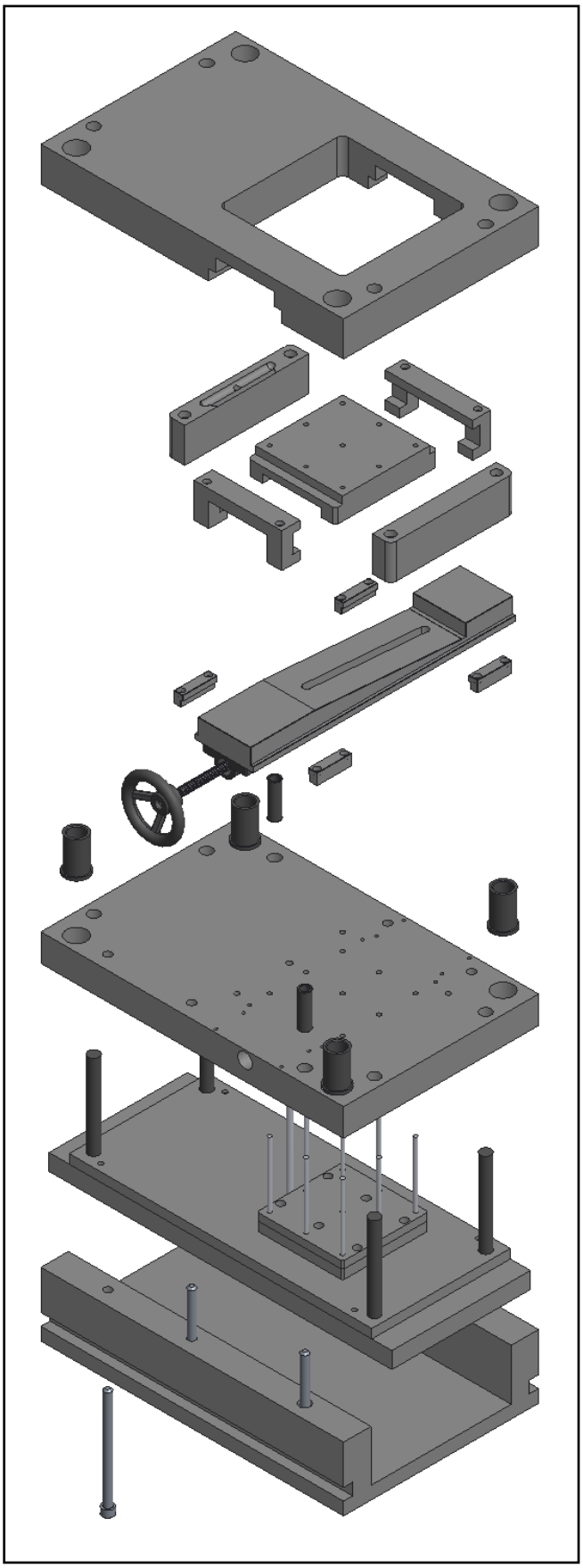


Photo of test fixture and carriage rail system with load and reference test specimens

mold with variable cavity depth adjustment was designed for molding 6” square plaques with thicknesses ranging from 0.025” to 0.225”. The injection mold was designed for real-time in-mold cavity depth adjustment. An Acme lead screw was used to provide linear positioning of a cam bar located under a movable cavity plate. One revolution of the lead screw provided 0.010” adjustment in cavity depth.

Each type of conductive metal fiber was blended with each of the polymeric resins in given weight percents. Statistical sample sizes for each thickness plaque were molded and the shielding effectiveness over a range of frequencies was measured in the test fixture. The user-friendly designs of the test fixture and adjustable cavity depth injection mold resulted in a thorough and efficient study.



Exploded assembly model of plaque mold cavity half with the Acme lead screw and cam bar for cavity plate adjustment

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