Loudspeaker Design Process

Designing a loudspeaker to achieve specific performance goals is a complex process; a lot of physics and engineering with a bit of "black magic" thrown in. But the basics are easy to grasp and essential to know if you're going to get the sound you want.

1. Establish target parameters

PERFORMANCE: Frequency response, sensitivity, power handling, impedance, are the primary specifications

MECHANICAL: Mounting requirements based on the space available especially speaker diameter, depth, and weight.

ENVIRONMENTAL FACTORS: Indoor, Outdoor, Temperature, Chemical resistance, flame resistance are typical factors.

2. Establish cost and delivery requirements

- Forecasted annual quantities and target cost are important factors. They drive many engineering considerations and decisions and are best discussed early in the project.
- Things that tend to increase the cost of a speaker
  - Larger frame or magnet size
  - Higher power handling
  - Light weight and compact Neodymium or Alnico magnets.
  - Cone body materials such as composites or special blends of paper.
  - Cone edge materials such as natural or synthetic rubbers.
  - Special treatments for more difficult environments
- Consider the total landed cost not just the piece price.
  - High quality vendor reduces costs of inspection, scrap, or defects
  - Does cost include VMI (vendor managed inventory) or Kan Ban?
  - Shorter lead times allow quicker time to market for customer
  - Complete assemblies and pre-assembled units allow lower costs.
- Consider Near-sourcing: Using vendors close to point of use reduce costs
  - Shorter lead times improves customer service and competitiveness
  - Reduced freight & duty costs over
  - Reduced delays due to customs or shipping delays
  - Reduced risk due to long supply chain management
  - Quick and easy communications
  - Intellectual property in production.
  - Keeping confidential information, confidential.

3. Design and engineering

- Project plan - Overview of how the speaker will be designed along with timeline and key milestones.
- Final agreement on performance specifications and acceptance criteria.
- Quoting any development costs. If the product requires extensive engineering there may be costs associated with created performance simulations and drawings.
    - Common tools in loudspeaker design are FEA, magnetic modeling (e.g. SpeaD, FineMotor, Magnet)
    - Solidworks to create 2D or 3D models.

4. From Plan to Prototype

- Engineering drawings and bill of materials (BOM), is the shopping list of all the parts (both custom made and "off-the-shelf") that go into the speaker.
- Quotes -- the drawings and BOM are sent to vendors who respond with quotes on their parts of the project for both samples an production.
- Functional prototypes -- once the customer approves the quotes, samples are ordered, inspected, built into prototypes and tested.

5. Performance Testing

- Complete testing is done on the samples to ensure that the target specifications are met. Initially this acoustical performance testing.
- Power testing may be completed to the customer's exact performance criteria and use.
- More advanced testing may include long-term reliability as well environmental testing to various Military or FAA standards.
- Prototypes are sent to the customer for their evaluation, test and measurement.

6. Production

- Once the product is approved, parts are ordered and pre-production builds and testing assures the production will meet the approved samples.
- To verify that every manufactured product meets its specs, every one undergoes performance testing; test such as frequency response, impedance, distortion, and other parameters. It's the final pass/fail check before a speaker goes to work delivering the sound you want.

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