Subject: Breakup modes and collapsing directivity
Posted by Wayne Parham on Thu, 15 Feb 2007 03:39:01 GMT
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Horns do a few things. They match moving impedance of the cone to that of the air. That helps efficiency. They act as acoustic filters. That modifies the response curve. And they act as directional control devices. That focuses the energy.The driver does some things that interact with the horn as a system. It also does some things independently. Two of those that are relatively independent of the horn are cone breakup modes and certain forms of collapsing directivity. These things aren't completely independent of the horn, as the acoustic load placed on the cone by the horn is different than the acoustic load of the cone in free air. This modifies cone flex, and breakup modes shift as a result. Collapsing directivity can be caused by a horn, particularly those that have curved walls and narrow throats. But even without a horn attached, a driver will enter breakup and it will begin to beam at some frequency.As the cone enters its breakup mode region, it becomes more efficient. It's behavior is less controlled, and response may become too peaky to be usable, but some drivers have reasonably well-behaved breakup modes that can be used to extend response past what the driver would do as a rigid piston. Parts of the cone move independently of the rest of the cone, and they move like ripples on a pond. These modes are resonant, so the speaker is pretty efficient though these bands.Another thing that happens at relatively high frequency, is that the driver starts to become directional. When wavelength is approximately equal to diameter, the pattern is roughly that of a 90° conical flare. As frequency rises, the pattern grows more and more narrow. As directivity collapses, the energy becomes more and more focused. So on-axis SPL increases as a result.These two things combine to make on-axis output significantly higher than the power response of a rigid piston. The diaphragm is no longer rigid, so mass-rolloff loses its meaning at some point. This is because the whole mass of the cone is not moving in unison. The concept of mass-rolloff is still right, but the mass that's moving isn't rigid anymore. It acts more like a lumped group of mass-spring systems. So the system just becomes more complex than what can be represented by a rigid piston. And since directivity is collapsing, on-axis response is greater even if power response stays the same. If power response is falling but directivity is rising at the same rate, then on-axis response will remain flat. If power response doesn't fall off quite as fast as directivity rises, then the on-axis curve will show rising response.