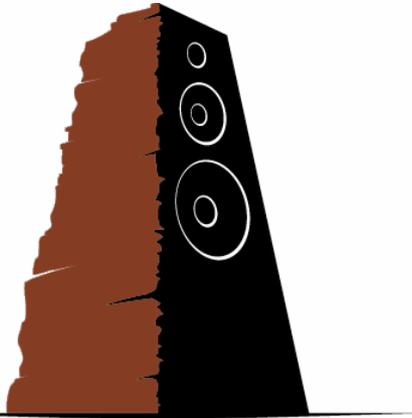
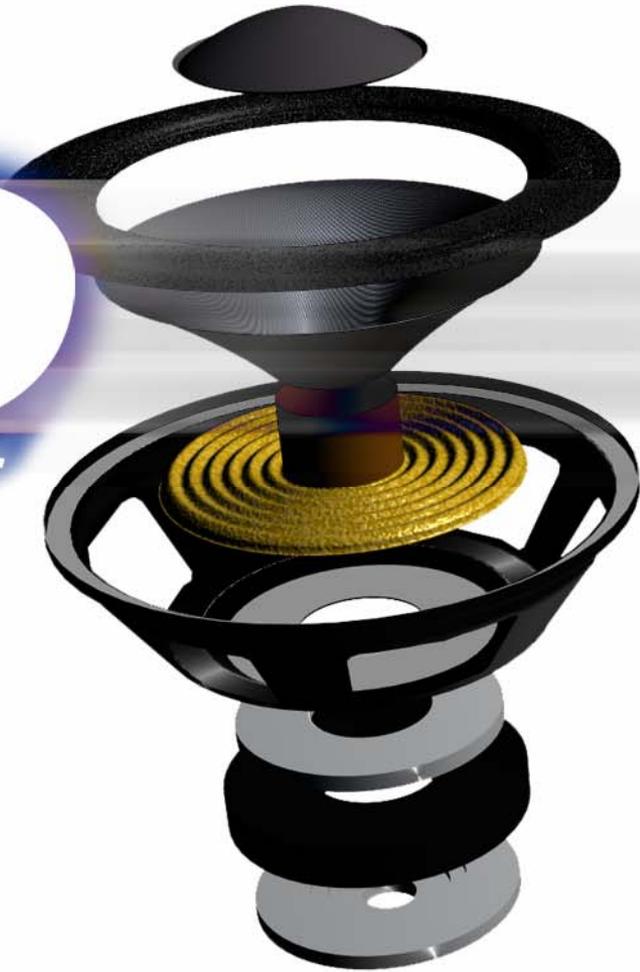


SpeaD

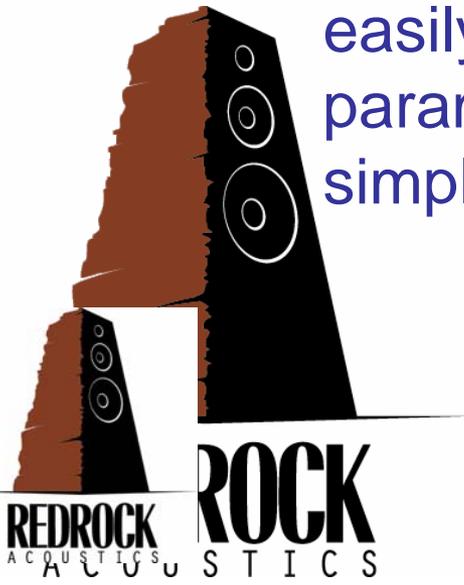
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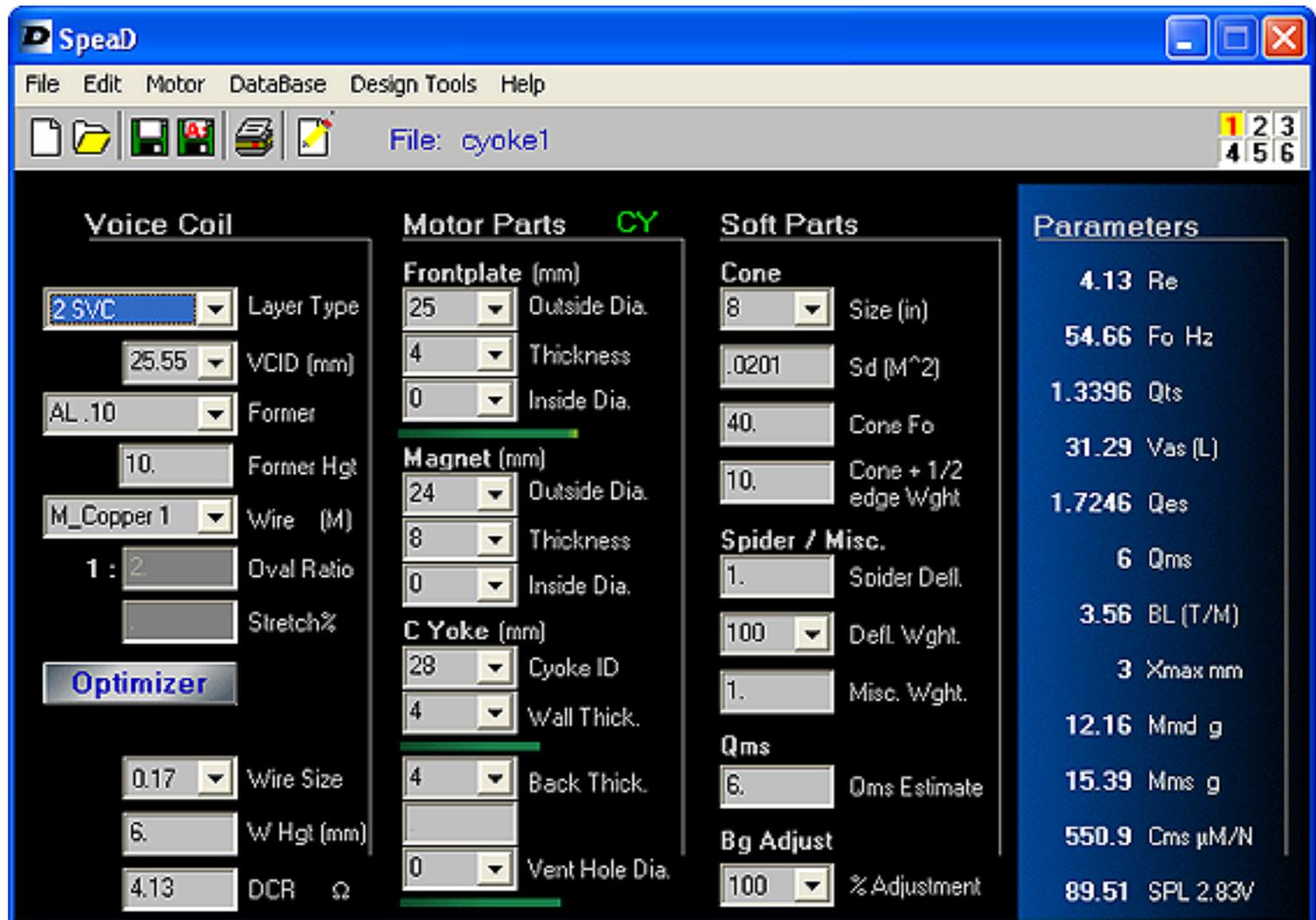
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What is SpeaD?

SpeaD is a revolutionary tool... that allows a speaker engineer to easily predict the Thiele / Small parameters for any speaker by simply describing its physical parts.



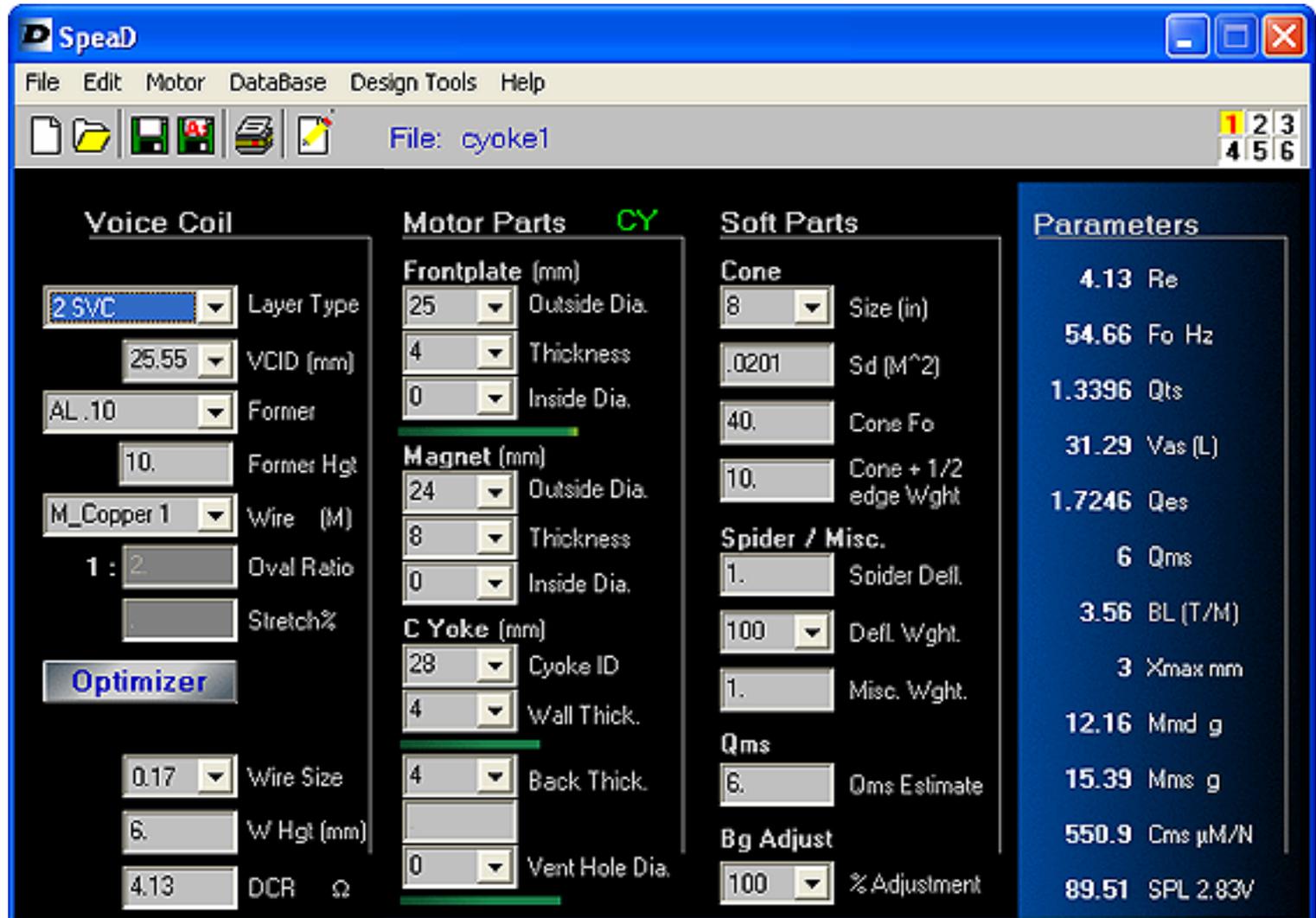
SpeaD is actually 3 tools that combine to create a complete speaker design.



SpeaD is actually 3 tools that combine to create a complete speaker design.



Voice Coil
Designer



SpeaD is actually 3 tools that combine to create a complete speaker design.



Voice Coil Designer

Magnet System Designer

The screenshot shows the SpeaD software interface with the following sections:

- Voice Coil:**
 - Layer Type: 2 SVC
 - VCID (mm): 25.55
 - Former: AL .10
 - Former Hgt: 10.
 - Wire (M): M_Copper 1
 - Oval Ratio: 1 : 2
 - Stretch%: [empty]
 - Optimizer: [button]
 - Wire Size: 0.17
 - W Hgt (mm): 6.
 - DCR Ω : 4.13
- Motor Parts CY:**
 - Frontplate (mm):**
 - Outside Dia.: 25
 - Thickness: 4
 - Inside Dia.: 0
 - Magnet (mm):**
 - Outside Dia.: 24
 - Thickness: 8
 - Inside Dia.: 0
 - C Yoke (mm):**
 - Cyoke ID: 28
 - Wall Thick.: 4
 - Back Thick.: 4
 - Vent Hole Dia.: 0
- Soft Parts:**
 - Cone:**
 - Size (in): 8
 - Sd (M²): .0201
 - Cone Fo: 40.
 - Cone + 1/2 edge Wght: 10.
 - Spider / Misc.:**
 - Spider Dell.: 1.
 - Defl. Wght.: 100
 - Misc. Wght.: 1.
 - Qms: 6.
 - Qms Estimate: 6.
 - Bg Adjust:**
 - % Adjustment: 100
- Parameters:**
 - 4.13 Re
 - 54.66 Fo Hz
 - 1.3396 Qts
 - 31.29 Vas (L)
 - 1.7246 Qes
 - 6 Qms
 - 3.56 BL (T/M)
 - 3 Xmax mm
 - 12.16 Mmd g
 - 15.39 Mms g
 - 550.9 Cms μ M/N
 - 89.51 SPL 2.83V



SpeaD is actually 3 tools that combine to create a complete speaker design.



Voice Coil Designer

Magnet System Designer

Soft Parts Designer

The screenshot shows the SpeaD software interface with the following sections:

- Voice Coil:**
 - Layer Type: 2 SVC
 - VCID (mm): 25.55
 - Former: AL .10
 - Former Hgt: 10.
 - Wire (M): M_Copper 1
 - Oval Ratio: 1 : 2
 - Stretch%: [empty]
 - Wire Size: 0.17
 - W Hgt (mm): 6.
 - DCR Ω : 4.13
- Motor Parts CY:**
 - Frontplate (mm):**
 - Outside Dia.: 25
 - Thickness: 4
 - Inside Dia.: 0
 - Magnet (mm):**
 - Outside Dia.: 24
 - Thickness: 8
 - Inside Dia.: 0
 - C Yoke (mm):**
 - Cyoke ID: 28
 - Wall Thick.: 4
 - Back Thick.: 4
 - Vent Hole Dia.: 0
- Soft Parts:**
 - Cone:**
 - Size (in): 8
 - Sd (M²): .0201
 - Cone Fo: 40.
 - Cone + 1/2 edge Wght: 10.
 - Spider / Misc.:**
 - Spider Defl.: 1.
 - Defl. Wght.: 100
 - Misc. Wght.: 1.
 - Qms:**
 - Qms Estimate: 6.
 - Bg Adjust:**
 - % Adjustment: 100
- Parameters:**
 - 4.13 Re
 - 54.66 Fo Hz
 - 1.3396 Qts
 - 31.29 Vas (L)
 - 1.7246 Qes
 - 6 Qms
 - 3.56 BL (T/M)
 - 3 Xmax mm
 - 12.16 Mmd g
 - 15.39 Mms g
 - 550.9 Cms μ M/N
 - 89.51 SPL 2.83V



Voice Coil Design Tool



Voice Coil Designer

Magnet System Designer

Soft Parts Designer

The screenshot shows the SpeaD software interface with the following settings:

- Voice Coil:** Layer Type: 2 SVC; VCID (mm): 25.55; Former: AL .10; Former Hgt: 10.; Wire (M): M_Copper 1; Oval Ratio: 1 : 2; Stretch%: [empty]; Wire Size: 0.17; W Hgt (mm): 6.; DCR Ω : 4.13.
- Motor Parts (CY):** Frontplate (mm): Outside Dia. 25, Thickness 4, Inside Dia. 0; Magnet (mm): Outside Dia. 24, Thickness 8, Inside Dia. 0; C Yoke (mm): Cyoke ID 28, Wall Thick. 4, Back Thick. 4, Vent Hole Dia. 0.
- Soft Parts:** Cone: Size 8, Sd (M) .0201, Cone 40., Cone edge 10.; Spider / Misc.: Spid 1., Defl. 100, Misc. 1.; Qms: Qms 6.; Bg Adjust: % Adjustment 100.
- Optimizer:** Layer Type: 2 SVC; VCID (mm): 25.55; Former: AL .10; Former Hgt: 10.; Wire (M): M_Copper 1; Oval Ratio: 1 : 2; Stretch%: [empty]; Wire Size: 0.17; W Hgt (mm): 6.; DCR Ω : 4.13.

At the bottom right, the results are displayed: **89.51 SPL 2.83V**.



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Voice Coil Design Tool



36 different coil types for virtually every possible coil design you can imagine.

These include:

1, 2, 4, 6, and 8 layers

1, 2, 3, 4 inputs

Bifilar, trifilar and quadfilar winding

Edge wound, flat wound, and inner/outer wound

All possible combinations of the above

A screenshot of the 'Voice Coil' design tool interface. The window title is 'Voice Coil'. It features a list of coil types on the left, including '2 SVC', '8 Quadfilar', '1 Edge', '1 Edge BF', '2 Edge I/O', '2 Edge BF I/O', '2 Flat SVC', '2 Flat BF', and '4 Flat SVC'. To the right of the list are labels for 'Layer Type', 'VCID (mm)', 'Former', 'Former Hgt', and 'Wire (M)'. Below the list is an 'Oval Ratio' field with a value of '1 : 2' and a 'Stretch%' field. A blue 'Optimizer' button is located below these fields. At the bottom, there are three input fields: 'Wire Size' with a value of '0.17', 'W Hgt (mm)' with a value of '6.', and 'DCR Ω' with a value of '4.13'.

Voice Coil Design Tool

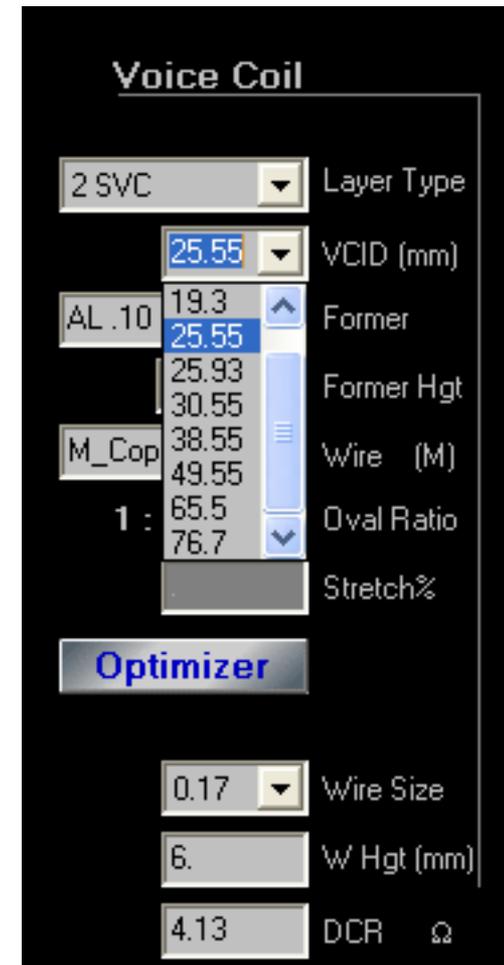


The voice coil Inside Diameter can be entered manually or you can choose from a list of standard coil sizes.

This list can be modified to include all of your factories' standard sizes.

Database files for standard sizes from Poyun and other Chinese suppliers are included with the software.

Additional database files can be loaded from the Redrock Acoustics website.



Voice Coil Design Tool

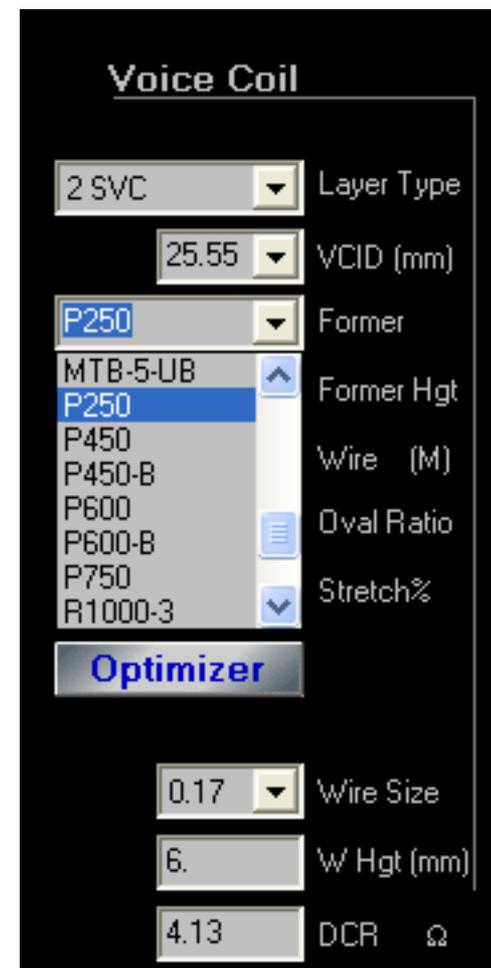


Former Materials are chosen from a database of standard materials. The database includes all of the important material properties.

This database can be modified to include all of your factories' standard materials.

Database files for standard materials from Poyun, other Chinese suppliers and Hisco are included with the software.

Additional database files can be loaded from the Redrock Acoustics website.



Voice Coil Design Tool



SpeaD uses wire databases that include specifications for each wire size. This is far more accurate than a simple resistance / mass calculation for a wire material.

Each wire type and size has a unique forming “history” that effects it resistance properties. This history can cause differences of more than 8% when compared to calculations based on its material alone.

SpeaD includes databases for Copper, CCAW, and Aluminum wire in both single and double builds from .1mm to more than 1.0 mm. (and equivalent AWG wire)

A screenshot of the "Voice Coil" design tool interface. The window has a dark background and contains several input fields and dropdown menus. The fields are labeled as follows: "2 SVC" (Layer Type), "25.55" (VCID (mm)), "P250" (Former), "10." (Former Hgt), "M_Copper 1" (Wire (M)), a list of wire types (Oval Ratio), "0.17" (Wire Size), "6." (W Hgt (mm)), and "4.13" (DCR Ω). The "Wire (M)" dropdown menu is open, showing a list of options: "AWG Type11", "CCAW Class 1", "CCAW Class 2", "Copper Class 1", "Copper Class 1.", "Copper Class 2", "M_CCAW 1", and "M_Copper 1". The "M_Copper 1" option is selected and highlighted in blue.

Voice Coil Design Tool



When edge or flat wound coil types are designed, the “Oval Ratio” and Stretch inputs become enabled.

“Oval Ratio” is the ratio of height to width of a flat coil wire.

The process of flattening a round wire, stretches the wire and changes its properties. SpeaD calculates these changes based on how much the wire stretches. The green number next to the stretch% input box is a “hint” for the typical stretch%

For wires that are formed flat, there are equivalent round wire sizes that can be used for its properties calculations.

A screenshot of the "Voice Coil" design tool interface. The interface is dark-themed and contains several input fields and dropdown menus. The "Voice Coil" title is at the top. Below it, there are fields for "Layer Type" (set to "2 Edge I/O"), "VCID (mm)" (set to "25.55"), "Former" (set to "P250"), "Former Hgt" (set to "10."), and "Wire (M)" (set to "M_Copper 1"). Below these are "Oval Ratio" (set to "1 : 3") and "Stretch%" (set to "12", with a green "12" next to it). A blue "Optimizer" button is located below the "Stretch%" field. At the bottom, there are fields for "Wire Size" (set to "0.25"), "W Hgt (mm)" (set to "6."), and "DCR Ω" (set to "3.238").

Voice Coil Design Tool



One of the most useful parts of the Voice Coil Design tool is the “Optimizer”

It allows you to quickly design a coil with your required specifications.

An two of the three input values of

Wire Size

Winding Height

DCR

Will calculate the third value.

A screenshot of the 'Voice Coil' design tool interface. It features a dark background with white and green text. The 'Voice Coil' section includes dropdown menus for '2 SVC' (Layer Type), '25.55' (VCID (mm)), 'AL .10' (Former), and 'M_Copper 1' (Wire (M)). Input fields show '10.' for Former Hgt, '1 : 2.' for Oval Ratio, and an empty field for Stretch%. A green 'Optimizer' button is present. Below, a 'Search' section has radio buttons and input fields for '0.17' (Wire Size), '6.' (W Hgt (mm)), and '4.13' (DCR Ω).

Parameter	Value
Layer Type	2 SVC
VCID (mm)	25.55
Former	AL .10
Former Hgt	10.
Wire (M)	M_Copper 1
Oval Ratio	1 : 2.
Stretch%	
Wire Size	0.17
W Hgt (mm)	6.
DCR Ω	4.13



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Voice Coil Design Tool



For example to find wire size:

This coil design used a target DCR of 4 ohms and a winding height target of 6mm

The winding height was entered last, so SpeaD found the wire closest to the targets and then adjusted the DCR to the closest value using that wire.

Voice Coil

2 SVC	▼	Layer Type
25.55	▼	VCID (mm)
AL .10	▼	Former
10.		Former Hgt
M_Copper 1	▼	Wire (M)
1 :	2.	Oval Ratio
		Stretch%

Optimizer

Search

<input checked="" type="radio"/>	0.17	▼	Wire Size
<input type="radio"/>	6.		W Hgt (mm)
<input type="radio"/>	4.13		DCR Ω



Voice Coil Design Tool



For example to find wire size:

This coil design used a target DCR of 4 ohms and a winding height target of 6mm

The winding height was entered last, so SpeaD found the wire closest to the targets and then adjusted the DCR to the closest value using that wire and winding height.

If the DCR is entered last, winding height is adjusted to the required DCR.

A screenshot of the SpeaD software interface for designing a voice coil. The window is titled "Voice Coil" and contains several input fields and a search section. The "Layer Type" is set to "2 SVC", "VCID (mm)" is "25.55", "Former" is "AL .10", "Former Hgt" is "10.", "Wire (M)" is "M_Copper 1", "Oval Ratio" is "1 : 2.", and "Stretch%" is empty. A green "Optimizer" button is visible. Below it, a "Search" section has three radio buttons: "Wire Size" (selected) with a value of "0.17", "W Hgt (mm)" with a value of "5.813", and "DCR Ω" with a value of "4.". The interface has a dark background with light-colored text and input fields.

Voice Coil Design Tool

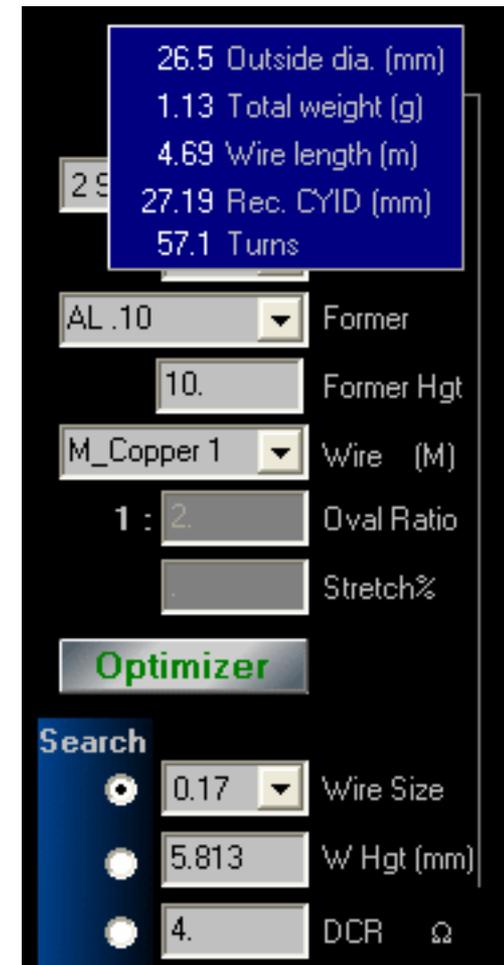


Once a Voice Coil Design is complete, more information about the design is available.

This includes:

- Outside Diameter
- Total Weight
- Wire Length
- Turns
- Recommended Frontplate or Cyoke ID

(Based on user-defined clearances and thermal expansion)



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Magnet System Design Tool



The SpeaD Magnet System Design Tool is by far the most complex component of the software.

Underneath the simple interface is a highly accurate model of the magnetic behavior of all of the motor parts.

Motor Parts CY

Frontplate (mm)

25	▼	Outside Dia.
4	▼	Thickness
0	▼	Inside Dia.

Magnet (mm)

24	▼	Outside Dia.
8	▼	Thickness
0	▼	Inside Dia.

C Yoke (mm)

28	▼	Cyoke ID
4	▼	Wall Thick.
4	▼	Back Thick.
0	▼	Vent Hole Dia.



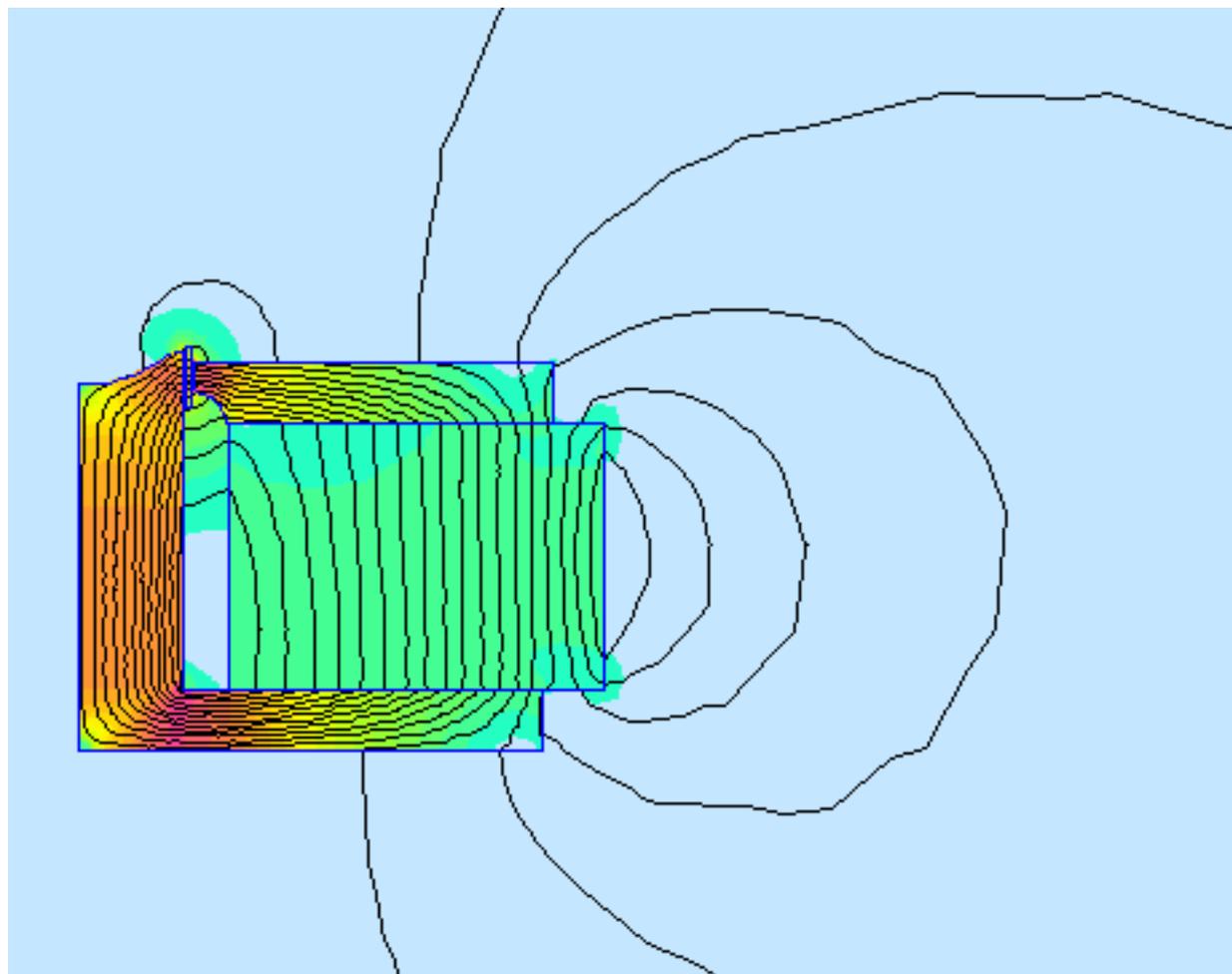
Magnet System Design Tool



Values are calculated for each of the Primary Permeance Paths
(The 12 lines outside the magnet and steel that you see in this flux plot.)

These paths are summed and the Permeance Coefficient is calculated.

The potential B in the metal parts is then calculated and a saturation model is applied using the BH curve of the material.



Magnet System Design Tool

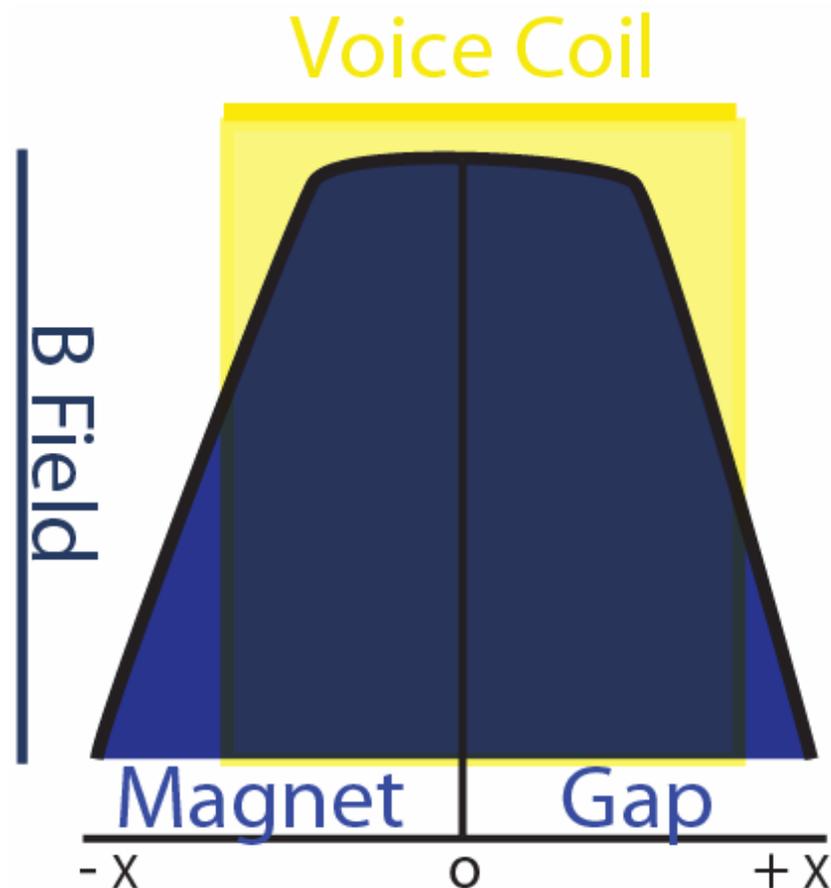


From these calculations, SpeaD creates a profile of the B Field including the stray flux outside of the gap.

The total B over the length of the voice coil is calculated.

This value is multiplied by the length of the wire and the result is a very accurate prediction of BL

Because SpeaD is actually calculating the energy in the area outside the gap, an accurate prediction of the functional Xmax can also be made.



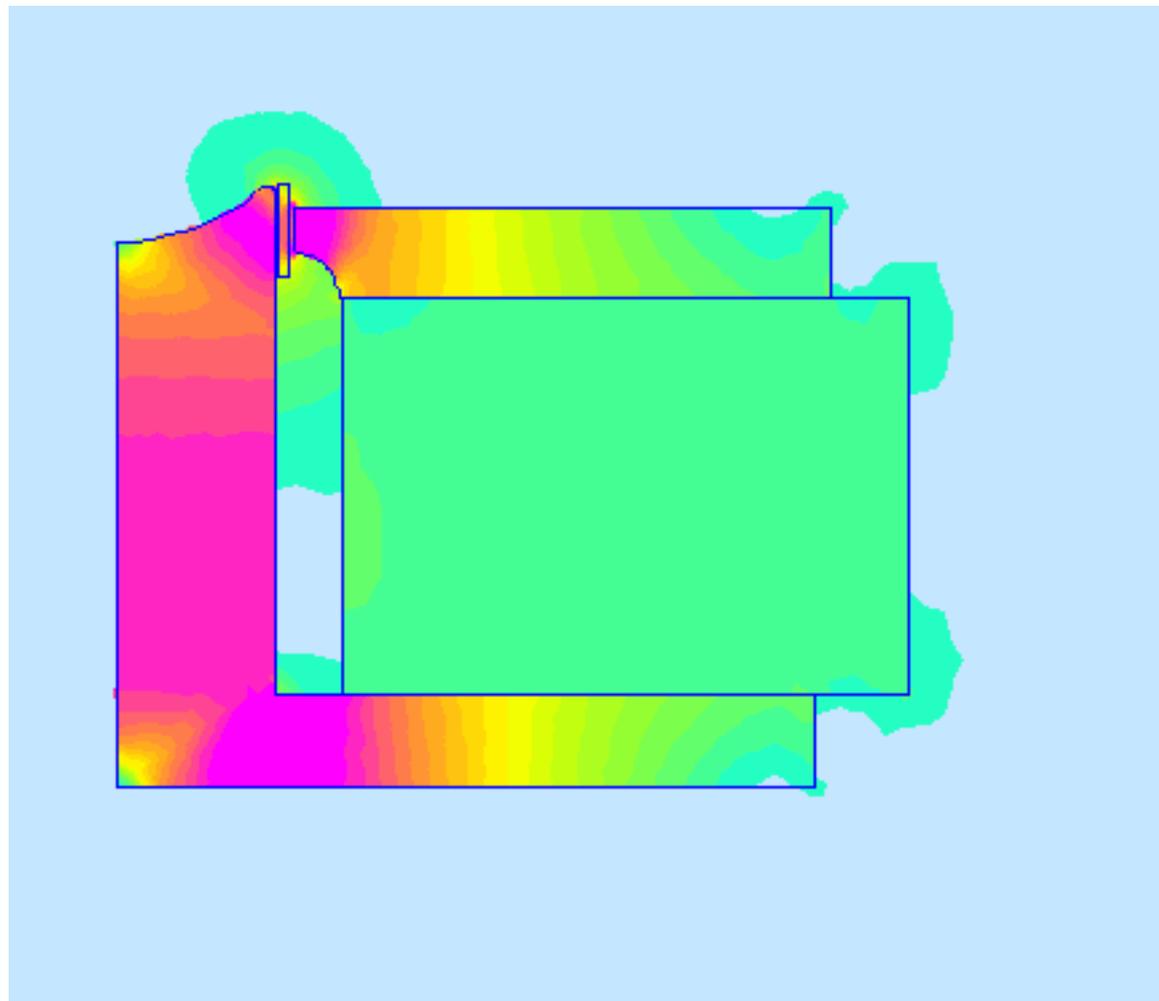
Magnet System Design Tool



SpeaD's models include a nonlinear prediction of saturation (all the of the red areas) using the BH curves of the steel parts.

Saturation is calculated in the Pole, Frontplate and Backplate for standard motors.

and the Frontplate, Cyoke walls and Cyoke back for cupped motors.



Magnet System Design Tool



The saturation levels for each part are shown by colored bars next to their input values.

Green bars mean that the part is not in saturation.

Yellow means that it has entered the knee of the BH curve and Red means that is in saturation.

An additional information window can be brought up that shows how close the part is to saturation and the amount of B lost as the part enters saturation.

In this case the back wall of the Cyoke is in the Knee area of the BH curve and a small loss of B has occurred.

A screenshot of a software interface titled 'Motor Parts' with a green 'CY' indicator. It lists parameters for 'Frontplate (mm)' and 'Magnet (mm)'. Each parameter has a dropdown menu and a corresponding colored bar below it. A blue tooltip window is open over the 'CYoke (mm)' parameter, displaying saturation and loss data.

Part	Parameter	Value	Status
Frontplate (mm)	Outside Dia.	25	Green
	Thickness	4	Green
	Inside Dia.	0	Green
Magnet (mm)	Outside Dia.	24	Green
	Thickness	8	Green
	Inside Dia.	0	Green
CYoke (mm)	-	0	Yellow

Additional data from tooltip:

- 0.03 Bg loss (T)
- 0.38 Bg loss %
- 90 FP Saturation %
- 70 Wall Saturation %
- Knee BP Saturation %

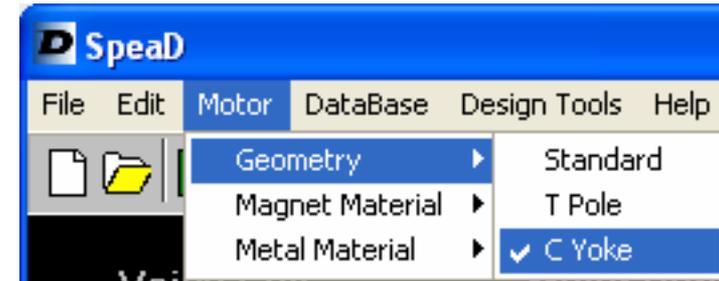


Magnet System Design Tool



The Magnet Design Models include:

- Standard Geometry (External Ring Magnets)
Including extended poles
- T Pole Geometry
- C Yoke Geometry (Internal Disc or Ring Magnets)

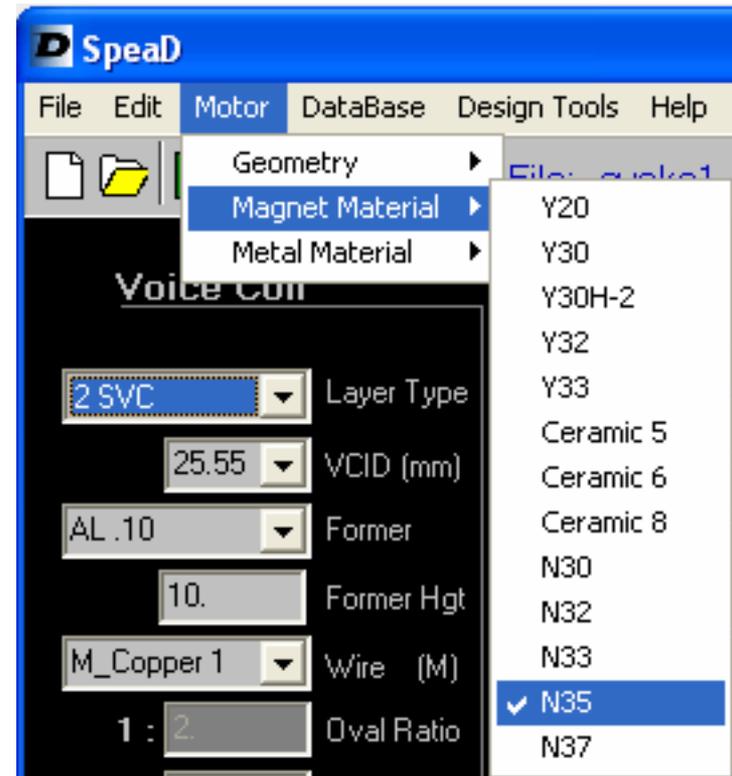


Magnet System Design Tool



A wide range of magnet materials is included with SpeaD and more can be easily added.

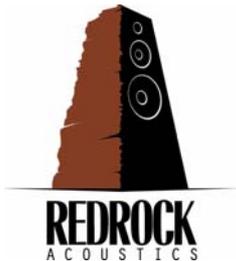
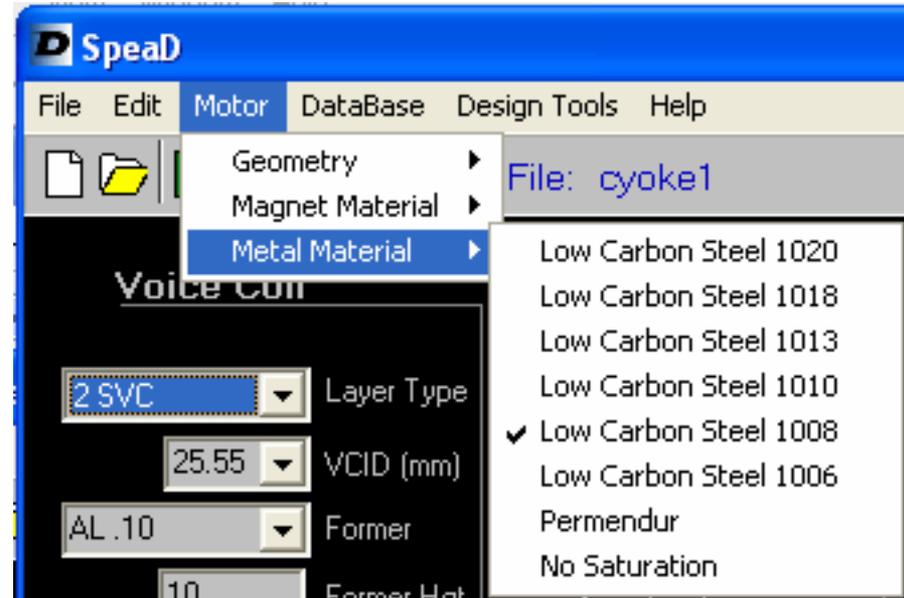
The standard database includes most common ceramic and neodymium magnet materials used in the US and China.



Magnet System Design Tool



Material data (BH curves) for most common steels are built into SpeaD.



Soft Parts Design Tools



The final information required for a SpeaD design is descriptions of the Cone and Spider, estimates of miscellaneous weight (dust cap, glue etc.) and finally, the Qms.

Soft Parts

Cone

8 Size (in)

.0201 Sd (M²)

40. Cone Fo

10. Cone + 1/2
edge Wght

Spider / Misc.

1. Spider Defl.

100 Defl. Wght.

1. Misc. Wght.

Qms

6. Qms Estimate

Bg Adjust

100 % Adjustment



Soft Parts Design Tools



The cone is defined by three parts:

Its Size or Sd

An editable list of standard sizes and their Sd's is available from a dropdown box.

The Cone Fo

A standard specification from all cone suppliers.

Cone and 1/2 edge weight.

This is simple, just cut 1/2 of the edge off and weigh the cone.

A screenshot of a software interface titled 'Soft Parts'. It contains several input fields and dropdown menus. The 'Cone' section includes a dropdown for 'Size (in)' set to '8', a text field for 'Sd (M^2)' with '.0201', a text field for 'Cone Fo' with '40.', and a text field for 'Cone + 1/2 edge Wght' with '10.'. The 'Spider / Misc.' section includes a text field for 'Spider Defl.' with '1.', a dropdown for 'Defl. Wght' set to '100', and a text field for 'Misc. Wght.' with '1.'. The 'Qms' section has a text field for 'Qms Estimate' with '6.'. The 'Bg Adjust' section has a dropdown for '% Adjustment' set to '100'.

Soft Parts	
Cone	
8	Size (in)
.0201	Sd (M ²)
40.	Cone Fo
10.	Cone + 1/2 edge Wght
Spider / Misc.	
1.	Spider Defl.
100	Defl. Wght.
1.	Misc. Wght.
Qms	
6.	Qms Estimate
Bg Adjust	
100	% Adjustment



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Soft Parts Design Tools



The spider is defined by its standard specifications:

- Deflection
- Mass added for deflection

It is important to note that deflection measurements are the single biggest cause for errors in SpeaD predictions.

Spiders are all non-linear. The stiffness at low deflections is much different than at high deflections.

It is important to measure a spider in the range it will be used.

SpeaD allows any mass to be used for the calculation and it may be necessary to ask your supplier to test with a large mass for some spiders.

A screenshot of the SpeaD software interface, specifically the "Soft Parts" configuration panel. The panel is dark grey with white text and input fields. It is divided into several sections: "Cone" with fields for Size (in), Sd (M^2), Cone Fo, and Cone + 1/2 edge Wght; "Spider / Misc." with fields for Spider Defl., Defl. Wght, and Misc. Wght; "Qms" with a field for Qms Estimate; and "Bg Adjust" with a field for % Adjustment. Each field contains a numerical value and a dropdown arrow.

Soft Parts Design Tools



When all data is completed, the results are instantaneous – A complete set of T/S data!

Changing any part value or description immediately shows the change in the parameter set.

Designing a new speaker or making changes to an existing product happens in minutes, rather than days or weeks waiting for parts to see the results.

How accurate are the predictions?

After literally thousands of speaker designs created with SpeaD, the answer seems to be about 5-7% error or better – with good data.

Parameters

3.7	Re
49.25	Fo Hz
0.9944	Qts
38.16	Vas (L)
1.1919	Qes
6	Qms
3.86	BL (T/M)
3.18	Xmax mm
12.32	Mmd g
15.54	Mms g
671.8	Cms $\mu\text{M/N}$
91.1	SPL 2.83V



Questions?

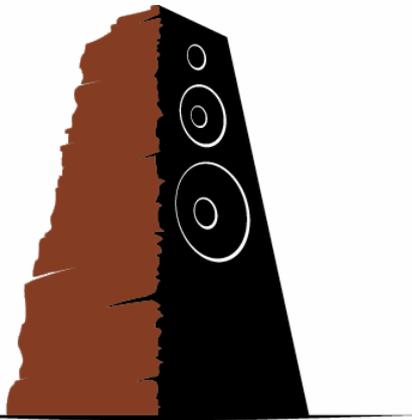
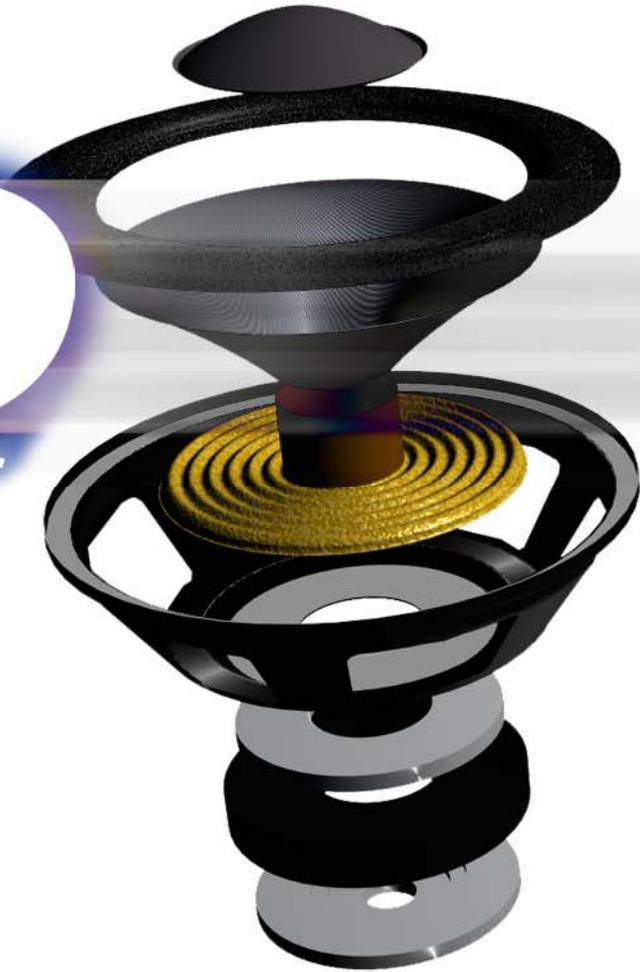


The screenshot shows the SpeaD software interface with the following sections and values:

- Voice Coil**
 - Layer Type: 2 SVC
 - VCID (mm): 25.55
 - Former: AL .10
 - Former Hgt: 10.
 - Wire (M): M_Copper 1
 - Oval Ratio: 1 : 2
 - Stretch%: [empty]
 - Optimizer: [button]
 - Wire Size: 0.18
 - W Hgt (mm): 6.361
 - DCR Ω : 3.7
- Motor Parts** **CY**
 - Frontplate** (mm)
 - Outside Dia.: 25
 - Thickness: 4
 - Inside Dia.: 0
 - Magnet** (mm)
 - Outside Dia.: 24
 - Thickness: 8
 - Inside Dia.: 0
 - C Yoke** (mm)
 - Cyoke ID: 27.2
 - Wall Thick.: 4
 - Back Thick.: 4
 - Vent Hole Dia.: 0
- Soft Parts**
 - Cone**
 - Size (in): 8
 - Sd (M²): .0201
 - Cone Fo: 40.
 - Cone + 1/2 edge Wght: 10.
 - Spider / Misc.**
 - Spider Defl.: 1.5
 - Defl. Wght.: 100
 - Misc. Wght.: 1.
 - Qms**
 - Qms Estimate: 6.
 - Bg Adjust**
 - % Adjustment: 100
- Parameters**
 - 3.7 Re
 - 49.25 Fo Hz
 - 0.9944 Qts
 - 38.16 Vas (L)
 - 1.1919 Qes
 - 6 Qms
 - 3.86 BL (T/M)
 - 3.18 Xmax mm
 - 12.32 Mmd g
 - 15.54 Mms g
 - 671.8 Cms $\mu\text{M/N}$
 - 91.1 SPL 2.83V

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